PUBLICATION OFFICES

168-177 POTTER BUILDING, NEW YORK.

Telephone Call: Murray 586. Cable Address: "Electrical," New York.

W. J. JOHNSTON, Editor and Publisher.

T. COMMERFORD MARTIN, JOSEPH WETZLER, } Associate Editors.
G. H. STOCKBRIDGE, Assoc. Editor Patent Department.
CLARENCE E. STUMP, Business Manager.
WALTER T. HUNT, Advertising Dept.

New England Office, 48 Congress Street, Boston.
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Potter Building, New York.
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VOL. XI. NEW YORK, MAY 26, 1888. No. 21.

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Portable Long Range Galvanometers. THE electrical engineer of to-day is required to undertake and investigate work of such widely varying character that an instrument which will enable him to determine current strengths of widely differing limits will be welcomed as a decided acquisition to his working apparatus. Electricians will, therefore, read with interest the description of Professor Moler's swinging arm galvanometer, which possesses these qualities in a remarkable degree, and which, in addition, has one of the great advantages so dear to the heart of the "practical" man, namely, that of portability.

A Loss to the Profession. IN the death of Mr. George M. Phelps, the well-known inventor, the electrical profession has sustained a severe loss. Some details of his career will be found on another page, where a passage is quoted which gives the keynote of an honored life: "Whatever he touches he beautifies." Restricting this pregnant phrase simply to Mr. Phelps' work, it is worthy of remark that the grace and finish characteristic of all his apparatus were the result of right methods of construction and operation, and that his genius, like that of all truly great designers, lay in the fit adaptation of material, mass and shape to the end sought.

An Investigation Needed. IN the paper presented by Mr. P. B. Delany, before the American Institute of Electrical Engineers, a suggestion is thrown out which, we think, ought not to be passed by unheeded. The causes of death by electricity, its nature and limitations as well as the probable means for its prevention, are of sufficient practical importance to warrant earnest investigation. We would suggest, therefore, the advisability of the appointment by the Institute of a committee to investigate and report upon this subject. The investigations which have thus far been undertaken in this direction have for the most part been isolated and limited in their scope, and there is thus left for the Institute a clear field for work the result of which will redound to its credit. We hope that this subject will meet with the attention it merits, and that light will be shed upon a still obscure subject.

Exit Drawbaugh. THE refusal of the Supreme Court to do anything more with the telephone suits just decided must give a quietus to the claims of Drawbaugh et al. There were no good reasons why a rehearing should be granted, and the action of the court was only what might have been expected. The lesson to those who believe that Drawbaugh invented the telephone is very pointed, and the moral is pertinent to all inventive effort, namely, that he who would secure to himself a great invention must not sleep on it, but must be instant in season and out of season. Perhaps it is for the purpose of tempering the wind to the shorn lamb that the news now comes with timeliness from Germany that a pension has been granted to the widow of Philipp Reis. This recognition is significant, at any rate, of German sentiment, and ought to console those who see the Reis biliteral cipher in Professor Bell's great work.

The Institute's New President. IT will be seen from the report given in our issue this week, that the American Institute of Electrical Engineers has entered upon its fifth year with a very successful general meeting, and with every prospect of continuing its good work successfully under a new board of officers. The choice of Mr. Edward Weston for president seems to us a very happy one. Mr. Weston is in the front rank of American electrical engineers, and his inventions and attainments have long since won for him an international reputation. The fact that at the present time he is not connected with any electrical corporation emphasizes the selection as being made purely upon personal grounds, and as being therefore, it may be said without impropriety, the higher compliment. We have not the slightest doubt that Mr. Weston will, with the support of the many other leading electricians who are in the council with him, render valuable service to the Institute, and that all who desire the welfare of the profession and science will seek to make his term of office memorable and distinguished in the history of the Institute.

The Limits of Primary Batteries. THE constantly recurring announcements of wonderful advances made in primary batteries, calculated to render the use of the dynamo unnecessary, form the basis of Mr. F. B. Crocker's able and pertinent Institute paper printed on another page. The belief in primary batteries, as available for heavy work, is so persistent, and so easily is the public led into ill-advised investment by false representations in this respect, that a concise and ready means of testing the truth of these claims of special value, particularly at this time, is of the utmost usefulness. Mr. Crocker shows just what can be expected of any given combination of materials, and his table of the cost per horse-power hour of voltaic battery energy, with different materials, will set at rest at once the hopes of those who seek to employ the present forms and the materials now in ordinary use. But the table, besides having value in this negative way, is quite as valuable in showing in what direction to work in order to improve the voltaic battery. For in spite of the comparatively little improvement which these electrical generators have undergone in the last fifty years, there seems reason to hope that with proper consideration of the elements involved, considerable advance may be brought about, when if they do not succeed in displacing the dynamo, which seems hardly probable, there will at least be a wider sphere of employment for them.

The American Telegrapher. OUR London contemporary, the *Electrician*, contained recently a very interesting article from Mr. P. B. Delany, being a contribution to the synchronous multiplex controversy. It is well worth reading for the light thrown on the points directly at issue, but what we now wish to note is the amusing little tilt that Mr. Delany has with M. La Cour in regard to the ability of the American telegrapher. M. La Cour remarks: "The Americans whom we had engaged, and who were supposed to be such eminent men, are possessed of considerably less theoretical knowledge than an ordinary telegraph operator in Scandinavia," to which Mr. Delany replies: "The American telegrapher needs no defense at my hands. He may not have as much theory as his Scandinavian brother, but he knows a practical telegraph system when he sees it, and it is well known that he can send more into and get more out of a telegraph wire than any other telegrapher in the world." After all, what is required of a telegrapher is practice and not theory, though a thorough acquaintance with the latter is desirable. Are we to attribute to the European's proficiency in theory the fact that he does so little to distinguish himself not simply in practice, but in something that displays the highest qualities of mind—invention? The ranks of European telegraphers contain, we know from personal acquaintance, many accomplished men, but where are the European Edisons, Delanys, Popes, Hamiltons, Gillilands, Lockwoods; or the European Morrisons, Metzgers, Johnsons, who not only invent but conduct great organizations and enterprises? There must be something to account for these and many other instances of advancement among telegraphers on this side the Atlantic, and for what appears to be the great rareness of such instances on the other side. What is the repressive influence in the Old World? Is it too much theory or too little ambition? Is it too much governmental control or too little individuality?

Underground Wires. THE paper read by Professor Plympton before the American Institute of Electrical Engineers, though short, embodies the results of careful consideration of a subject which has led to much discussion in this country. Briefly stated, Professor Plympton has come to the conclusion that there is no difficulty in putting telegraph and telephone wires underground and maintaining them there in good condition for a lengthened period of time. Some details of course still remain to be settled, but much has been gained in the knowledge of what has to be avoided. The question of putting incandescent light wires underground has also been solved, and the test of several years' service has shown that the system is an undoubted success. But as regards the burial of the arc light wires Professor Plympton wisely has his doubts as to the certainty of success with any method yet tried, and he, as well as his associates, has the good sense to recognize that any hasty and ill-advised enforcement of the law controlling the burial of these wires "would prove the surest way of perpetuating the nuisance of overhead wires and poles in the street." In other words, he has come to the conclusion that if put underground by any method thus far tried the result would be failure, and another resort would have to be made to overhead wires, which would then stand all the more firmly against any attempt to enforce their burial. Professor Plympton also drew attension to the fact noted by us last week, that such alleged accidents as a death caused by the grasping of a naked wire close to an arc lamp could not be prevented by any system of burying wires, and that perfect immunity could only be obtained by burying both the wires and the lamps. Regarding underground wires in Europe, probably the best idea of the extent to which the practice prevails abroad was seen in the photographs which Professor Plympton drew attention to during the meeting, embracing views taken in various cities visited by him during his recent trip of investigation. In some cases the network of wires was almost, if not fully, equal to the masses familiar to us here, and, as the speaker remarked, it was only in exceptional cases that underground work was found.

The Safety of Electric Lighting. THERE seems to be some misconception as to the attitude of electricians towards gas interests, and it comes out in a remark made by our esteemed contemporary, the *Progressive Age*, to the effect that the electrical journals are now and then "disposed to sneer at gas and make contrasts which are misleading." The remark is offered in regard to a note in this column lately on the agitation against the electric light wires and on the greater safety of electricity as compared with gas or any other illuminant. Now, it may truly be said that if there is one thing the electrician does not worry about it is gas-lighting. He knows that it has its place and that its competition becomes every year less severe; and such a situation he accepts with complacence and equanimity. We have seen regular lists kept in gas journals of alleged electric light accidents, but we have never yet seen an electrical journal bother about doing any thing of that kind with respect to gas. Our own remarks in this case were not a criticism on gas, but an ordinary comparison, and that not with electric lighting, but with *arc* lighting. Had a more direct contrast been sought, we should certainly have included incandescent lighting, which with its millions of lamps in daily service has proved to be the acme of safety, yet comes in far more for handling than does the arc light. Our contemporary thinks that "both gas and electricity, under certain conditions, are dangerous elements, but their value is beyond any danger their use implies." Agreed. One of the leading railroad papers in this country compiles every month, with great skill and accuracy, a list of railroad casualties, making a study full of interest and value. But we are not aware that any electrical journal has used that list to prove that electricity would be better than steam to operate railroads with; though we are quite prepared to see attempted by some partisan, by and by, the compilation of a list of accidents on electric railroads, or long articles on them in the daily papers, to show that electricity as a motive power is all wrong. Electric railways will not be checked, however, by that, and they, like the electric light, will be evidences of the truth that the useful stays. We do not regard electricity as something to "knock out" gas or steam with, and we may interject the observation that things which it is sought to "knock out" generally stay the longer. As far as we have traced the course of progress, the new things have established themselves, not so much by ousting the old things completely, as by defining more precisely the limits within which the use of the old is desirable and the use of the new is advantageous.

Improvements in the Quadruplex.—II.

BY WM. MAVER, JR.

In addition to the back contact repeating sounder arrangement invented by Edison to prevent the false signal on the No. 2 side due to the reversal of the entire distant battery, at least four other general methods designed to effect the same result have been devised.

Before describing these it should perhaps be mentioned that there is one effectual means of obviating this particular trouble. It consists in the use of a polarized relay equipped with springs and extra levers, which operate to reproduce the signals transmitted by the distant No. 2 transmitter.

This relay is shown in Fig. 4. It is an ordinary polarized relay *P R*, with the addition of two extra levers *L L'*. The springs *S S'* hold these levers against the extended contact points of the armature lever *A* in such a manner

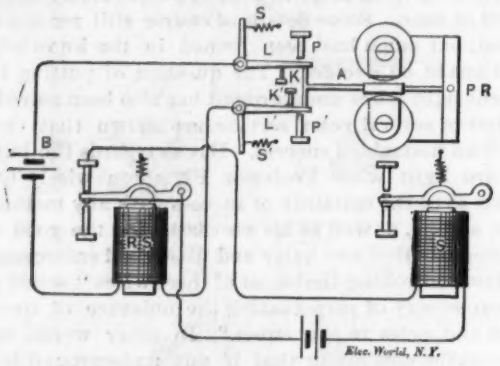


FIG. 4.—COMPOUND POLARIZED RELAY.

that when the "small" end of the distant battery is to the line the local circuit *B* is closed through the levers. When the entire distant battery is put to the line the armature *A* is drawn against, let us say, the stop *P'*, and as the lever *L* cannot follow the armature *A* beyond the stop *K*, the local circuit is opened and a signal recorded. If, while this signal is being made, the distant battery is reversed, the effect will be that the armature *A* will jump over from P' to *P*, still keeping the local circuit *B* open. It will be noticed that during this transit there is a moment when the local circuit is closed, as in Fig. 4, but the time of closing is so short that it does not perceptibly affect the local sounder *R S*.

The repeating sounder *R S* might be dispensed with when this relay is used by the simple expedient of arranging the distant transmitter so that when it is open the full battery is placed to the line, and when closed the small portion.

This form of No. 2 relay, known as a compound polarized relay, was at one time employed extensively, but considerable objection was raised to its use, owing to difficulty in keeping its various springs and levers adjusted, and it was, as already intimated, finally abandoned for the short core neutral relay.

Figs 5 and 6 illustrate more or less successful methods of bridging over the effect of the distant reversal in the neutral relay. In these methods the armature lever of the No. 2 relay is extended and supplied with an extra armature opposite an extra electro-magnet. These electro-magnets *E M* are placed in the circuit of a condenser or that of a secondary coil, momentary currents from which it is intended shall magnetize the extra magnets at the

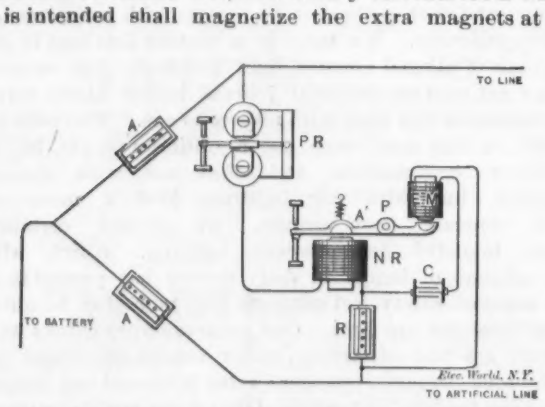


FIG. 5.—CONDENSER AND EXTRA MAGNET ARRANGEMENT.

moment of "no magnetism" in the main line cores of the No. 2 relay, and thereby prevent the armature from falling back at that instant.

Fig. 5 illustrates one of the earliest arrangements in which the extra magnet and extended armature was used in combination with a condenser. At the time when this device was used, about 1874–75, the "bridge" method shown in the figure was employed to render the "home" relays indifferent to the home battery. *A A* are the arms of the Wheatstone bridge, *P R* is the polar relay. The extended lever *A'* is pivoted at *P*. A resistance *R* was placed in the bridge wire. The terminals of condenser *C* were attached to the opposite ends of this resistance and the condenser circuit passed through electro-magnet *E M*. Owing to its position in the bridge wire the condenser would not be affected by the home battery. The function of this resistance was to produce a fall of potential between the plates of the condenser when the distant battery was to the line. When that battery was momentarily cut off during the instant of reversal, the previously accumulated charge was then discharged through the extra magnet *E M*, holding the armature against its front stop during the moment of no magnetism. This device did not go into very general use, as the loss of "margin" due to the bridge method of working the quadruplex led to the early abandonment of that method.

Fig. 6 shows an arrangement, the authorship of which is claimed by several inventors, and the question is not yet decided.

This arrangement consists of an induction coil *I*, termed an "inductorium," with two primary coils, one of which is in the main line and one in the artificial line circuit—both so wound that the home battery tends to produce an equal and opposite, and consequently no effect on the secondary coil. The circuit of the secondary coil is conducted through the extra magnet *E M*. The "inductorium" is furnished with a movable core, by means of which the induced current may be increased or diminished as required. The distant battery brings about an excess of current in one or other of the primary coils, and at reversals of said distant battery those coils in discharging and charging set up momentary currents in the secondary coil, which magnetizes the extra magnet *E M*, as in the case of Fig. 5, and with the same result, that is, to keep the armature *A* against its front stop *S* during the moment of no magnetism in the core of the No. 2 relay *N R*.

This device has been used with favorable results by the Postal Telegraph Company. It is perhaps open to the objection, as compared with methods in which the condenser is used to produce the momentary currents, that the magnetic resistance of the primary coils tends, by retarding the reversal of the line current, to make the change in the magnetic polarity of the relays more gradual. Of course, this objection fails if the arrangement is competent to compensate for its own retardation, added to that of the line.

The retarding and detrimental effect of electro-magnets in a quadruplex circuit was very noticeable in a series of experiments made with the Van Rysselberghe system of simultaneous telegraphy and telephony, a few years ago, in which electro-magnets of high resistance were used to "graduate" the telegraph currents so that they should not be heard in the telephone. On very long quadruplex circuits this retarding effect was so marked that the No. 2

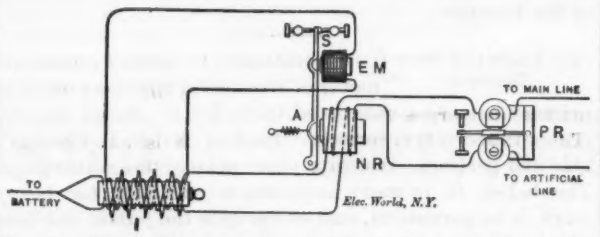


FIG. 6.—INDUCTION COIL AND EXTRA MAGNET ARRANGEMENT.

side was rendered practically inoperative, and efforts to restore its efficiency by all the known, and several new, devices were futile.

Messrs. Moffatt & Blakeny jointly invented an induction coil "bug trap," somewhat analagous to that just described, which is said to have been quite successful. The arrangement has already been described in this journal. The most important feature of this device consists in the employment of a continuous core in the induction coil, forming a closed magnetic circuit, whereby a strong momentary current is obtained with a comparatively low resistance in the primary coils. A decided advantage is gained thereby.

Another plan, shown in Fig. 7, different from the foregoing, is one in which a condenser *C* is placed between the main and artificial lines at points between the polar relay *P R* and neutral relay *N R*. This arrangement is the invention of Mr. F. W. Jones. The condenser depends for its difference of potential on the resistence of both coils of the No. 2 relay. Owing to its position between the main and artificial lines the condenser *C* is not affected by the home battery.

The theory of operation of this device is that at the moment of reversal of the distant battery the condenser discharges its previously accumulated charge through the coils of the neutral relay in a way to at once reverse the magnetic polarity of its core, and thus shorten the moment of "no magnetism."

Generally speaking this arrangement, while beneficial on some circuits, was not a decided improvement, the partial cause of which may have been that a sufficient fall of potential between the plates of the condenser was not secured by the resistance of the coils of the neutral relay, and consequently the momentary currents produced thereby may have been too weak to effect marked results.

Somewhat akin to the last device, but much more efficient, is the arrangement shown in Fig. 8, and already alluded to as the invention of Mr. Gerritt Smith. *R R'* are plain adjustable resistances of about 600 ohms each, placed in the main and artificial wires. Condenser *C* is placed between the same wires at points between *R R'* and the neutral relay *N R*. The No. 2 relay *N R* is furnished with a third coil, which is included in the circuit of condenser *C* as shown. The function of resistances *R R'* is to furnish a difference of potental between the plates of the condenser *C*.

This arrangement is devised not to hold the armature of the No. 2 relay passive against its front stop at the moment of "no magnetism," but like the Jones condenser arrangement, last described, is to cause a very rapid change of magnetic polarity of that relay.

As in the case of the devices already described the condenser *C* is in a position not to be affected by the "home' battery.

When the distant battery produces a difference of potential between the poles of the condenser *C*, that instrument in taking a charge sets up a momentary current, which is caused to traverse the extra coil in a direction tending to assist the regular current in magnetizing the core of the No. 2 relay. Its discharging current will, of course, be in the opposite direction, and hence, at the moment of reversal of the distant battery, the condenser, before the effect of that reversal would be perceptible in the No. 2

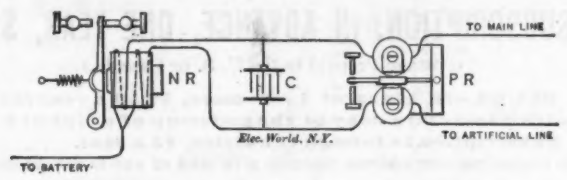


FIG. 7.—JONES CONDENSER ARRANGEMENT.

home relay, reverses its magnetic polarity and thus reduces the moment of no magnetism to a minimum.

This invention has been adopted as the present standard of the Western Union Company for this purpose, and its use has decidedly increased the working margin of the No. 2 side, especially in fair weather. In wet weather, however, its effectiveness is somewhat handicapped by the resistances *R R* in the main line which reduce the receiv ed current.

"On Death by the Electric Current."

BY DR. ROBERT AMORY.

In the issue of THE ELECTRICAL WORLD of May 19 is an article by Prof. E. J. Houston entitled as above, being an abstract from Proceedings American Philosophical Society.

It would hardly be right to allow the explanations of the cause of death by high tension currents as given by Prof. Houston to go unchallenged in the light of physiological knowledge as possessed by medical men of the present day.

According to this knowledge, acquired by experiments on animal life, as well as the observation of pathologists on the appearance of human bodies of those who have been destroyed by lightning and strong electrical currents, medical men are of the opinion that most generally death by electricity is caused by asphyxia rather than by any chemico-physical effects upon the living tissue.

In support of this opinion, the comparison of post-mortem appearances of the body of an animal destroyed by electricity shows a similarity with the appearances of the body of individuals destroyed by drowning or other forms of death by asphyxia.

The animal tissues, after death by lightning or other strong electrical action, do not decompose any sooner than after any other form of sudden death. Moreover, attempts at resuscitation of an individual apparently lifeless, after the passage through the whole body of a strong electrical current, should be resorted to, which are usually effectual in restoring the animal functions of life in those who have

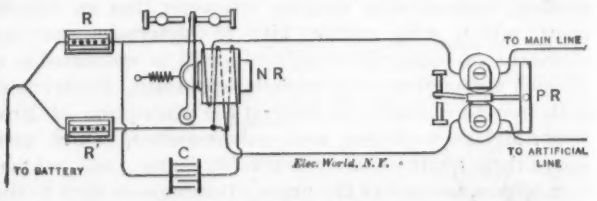


FIG. 8—SMITH CONDENSER ARRANGEMENT.

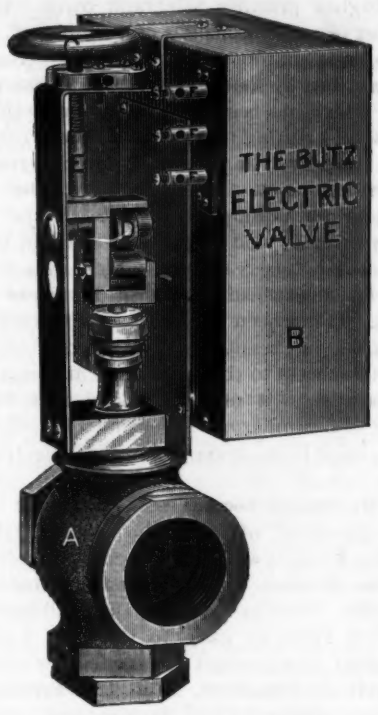
been subjected to asphyxia and cease to breathe. These attempts should be made by efforts to restore the respiratory movements, and are often successful even when there is apparently no hope of resuscitation. It will be evident that if a living body is held between two conductors of opposite potentials of electrical condition and receives the full current between a very high electrical potential passing to a very low potential, and cannot be extricated in time, the animal functions of muscular contraction are thrown into a strong tonic spasm, which will prevent the free respiratory movements which are essential to life. If these conditions are maintained for a sufficient period of time, the natural movements of respiration are delayed long enough to suspend the movements of blood in the capillary circulation. Thus the tissues are paralyzed and oxidation of the blood ceases, and in consequence the blood ceases to stimulate the heart to action.

This is a brief description of a more correct explanation of death by strong currents of electricity than any which is dependent upon electrolytical action of the tissues, suggested by Professor Houston.

The Butz Electric Valve.

We have already described some of the heat regulating and ventilating apparatus invented by Mr. A. M. Butz, of Chicago, and are now enabled to illustrate a novel form of steam valve designed by him, and intended to be worked in connection with his system.

As will be seen in the accompanying illustration, the valve *A* can be used as an angle or straight way valve. The steam enters the chamber surrounding the core in which the double valve seats are held closed by the valve stem *E*, and eccentric *D*. The upper seat being necessarily a little larger than the lower, the steam pressure



THE BUTZ ELECTRIC VALVE.

helps to hold it the more firmly. When the temperature falls, the "opening circuit" on the thermostat is closed, and the motor *B* revolves the shaft and eccentric *D*, opening the valve seats and allowing the steam and water to pass in and out freely in case the valve is used on the single pipe system.

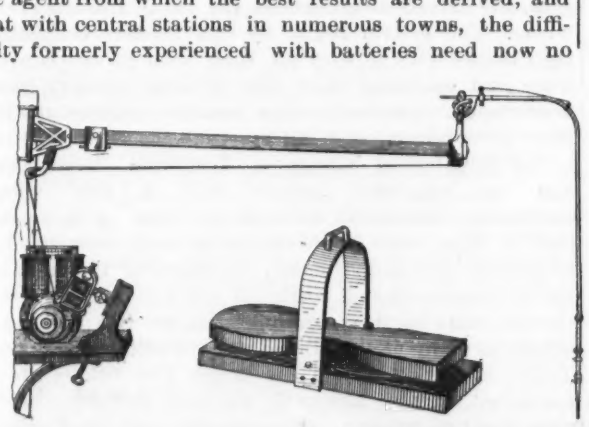
When the temperature rises above the desired degree, and closes the "closing circuit" on the thermostat, the motor again revolves the shaft and eccentric *D* half a revolution, tightly closing the valve seats, and shutting off the steam.

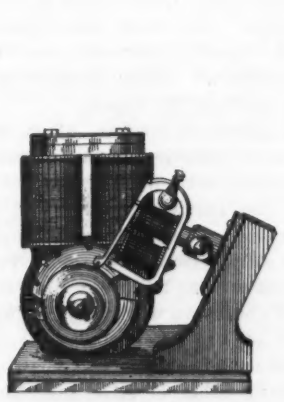
Should it be required for any reason to open or close the valve without the aid of electricity, this can be done by loosening a set-screw on the eccentric *D* and resorting to the wheel *C* to raise or lower the valve stem.

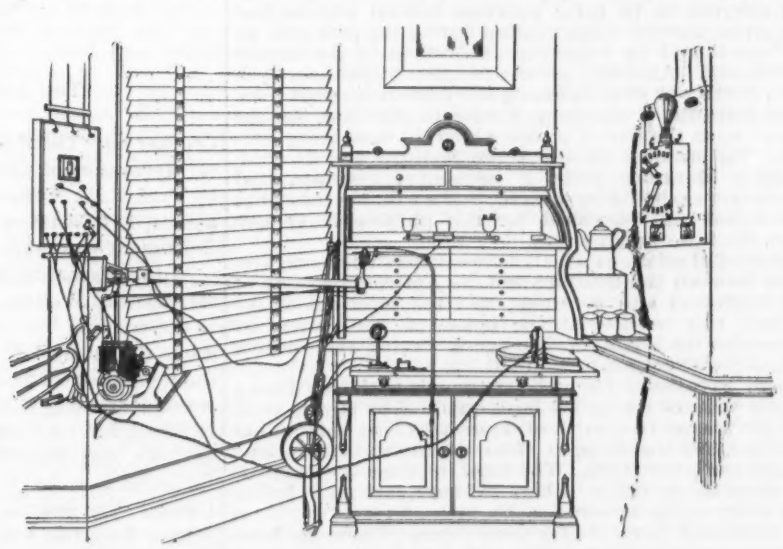
Dental Electrics.

In a recent number of the *Dental Review*, Dr. C. E. Kells, Jr., of New Orleans, gives a very interesting account of the manner in which he has applied electricity to the operations of the dentist. He shows conclusively that for many of the dentist's purposes the electric current is the agent from which the best results are derived, and that with central stations in numerous towns, the difficulty formerly experienced with batteries need now no further be considered. Dr. Kells has employed a C. & C. motor for driving a dental engine, the arrangement being shown in Fig. 1. Below the swinging arm is placed the motor, supported on a shelf, and connected to the engine by an ordinary band. The little apparatus shown a short distance to the right, in front of the motor, is the brake, which is an important feature of this installation, as by its means the engine may be stopped at once. The motor and brake are shown enlarged in Fig. 2, from which it will be seen that the brake consists of a clutch operated by an electromagnet, a simple and exceedingly effective device. When the current is on the motor, the engine band slips freely through the clutch, but when the current is changed to the magnet of the brake the band is gripped and the engine stopped instantly, while the momentum of the motor may continue to revolve the wheel for several seconds longer.

The apparatus, Fig. 3, shows the device employed for controlling the motor, and it will be seen to be operated and moved by the foot, thus giving the operator the free use of his hands. When in the position shown in Fig. 3 the rocking foot plate is maintained horizontal by springs and the motor does not run. By pressing the heel upon the board, electric contact is made and the motor is started, and continues running as long as pressure is maintained. The pressure upon the toe changes the current to another set of contacts, cutting out the current to the motor and sending it into the electro-magnetic brake, which stops the engine instantly, as described above. For varying the speed of the burrs a rheostat is employed which shunts resistances round the motor, and thus varies its speed to any desired degree. During the summer Dr. Kells also drives a fan for cooling purposes by means of the electric motor, and to slow it down to the proper speed, a lamp is used as a resistance instead of wires. This lamp is immersed in a little jar of water, which it keeps at just the right degree of warmth for use in the syringe. Thus the same agent that is used to keep the office cool, and the operators comfortable, is also employed to heat the water for their use, and to add to their convenience in that way. The office equipment is shown in Fig. 4. Dr. Kells believes that he is the first one to apply the current from a central station to the various operations met with in a dental office, and although his apparatus is all original with him, he freely gives its use to the public.







FIGS. 1, 2, 3 AND 4.—ELECTRICAL APPARATUS IN THE DENTAL OFFICE.

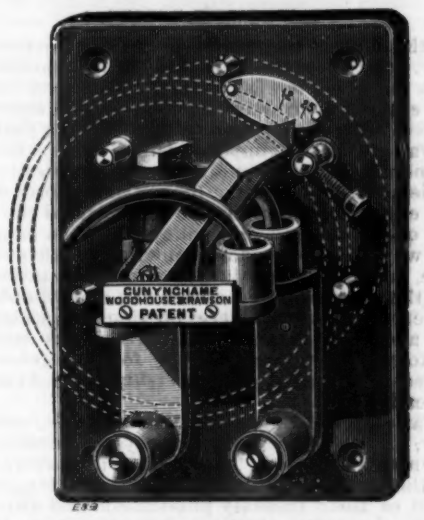
The Seel Incandescent Lamp Filament.

We have already noted the fact that an incandescent lamp having a filament of novel qualities had been brought out abroad by Herr Carl Seel, of Berlin, and in a patent just issued we obtain more detailed information regarding the nature of the filament. The characteristic peculiarity or it is that the incandescent threads are formed of three annular layers, of which the innermost is the real carbon thread, which is saturated with mineral salts and a gum, and is thus provided with a non-conducting silicate or coating of a salt that melts during the carbonization. This coating not only protects the carbon thread from burning during the carbonization and excludes the air from it, but it also gives the carbon thread a smooth surface, on which the third layer, which is necessary for the adjusting of the resistance of the filament, is deposited in a finely-divided and uniform manner. The third layer is composed of carbon, which is precipitated in a certain manner, a paraffine bath being used for the purpose.

The method of preparing the threads is as follows: Wood, silk, cotton, or any other vegetable fibre is steeped in a solution of mineral salts and a gum, consisting of a mixture of a silicate or salt, gum-senegal, and caustic soda, and then rolled firmly between warmed grooved rollers. It is rolled, besides, in the shape of angle-iron, in order to combine the advantage of great resistance with that of being a many-edged material of small diameter, so as to increase the illuminating effect.

When this operation is finished, the thread is carbonized in the usual way. The carbonized thread is then placed in an insulating vessel and connected to the terminals of a source of current, in the circuit of which is placed a regulating resistance. The vessel containing the thread is then completely filled with paraffine or naphthalene, so that the thread is completely immersed and the paraffine allowed to harden. Current is then passed through the filament, which heats up, and the parts of the paraffine close to it become liquid, and those closest to it even vaporized. In consequence of the heating, particles of carbon are deposited on the thread, and, owing to this, the resistance of the latter decreases gradually. The parts of the paraffine farthest removed from the charcoal threads remain solid and form an envelope for those parts of the paraffine that are liquid and limit the liquifying of the material as much as possible as well as excluding the air. When the carbon thread has been lowered to the right degree of resistance, the current is cut off and the thread is ready for use. After the paraffine has been made perfectly liquid by heating it, the carbon thread can be drawn out. It is then cleaned of the paraffine particles attached to it by means of benzine and is then ready to be inserted in the lamp. Hence the actual regulating of the resistance of the carbon thread takes place in the bath, only the very smallest part of which melts.

The advantages claimed for this method of treatment is that owing to the gum-senegal being used, it completely fills up the pores of the thread and makes the latter exceedingly tough and gives it great powers of resistance. The silicate and the caustic soda, on the other hand, encompass the thread entirely, and when the latter is subjected to the rolling process they encircle it closely and uniformly on all sides. After being carbonized and prepared, the thread, therefore, consists of three layers; namely, the inner carbon layer, the annular silicate layer, and the uppermost precipitated, so called "regulating layer," formed by the deposition of carbon.



CUNYINGHAME'S MAGNETIC CUT-OUT.

Cunyinghame's Magnetic Cut-Out.

In order to avoid the use of fusible plugs, Mr. Cunyinghame some time ago devised an automatic cut-out which is designed for use in all cases where it is required to sever or make an electric connection on the current or E. M. F. exceeding or falling below a given limit. The cut-out, which has recently been improved, is manufactured by The Woodhouse & Rawson Electric Supply Company, of London, and is shown in the accompanying illustration. Its action depends upon the raising of an armature against the action of gravity when the current passing round a small coil exceeds what the instrument was adjusted for. On the armature being drawn up, it draws two copper legs out of two mercury cups and thus severs the connection. The moment before the connection is severed, the armature falls over by its own weight to the other side and completely breaks the circuit. Two legs can be put on to the other side to fall into mercury cups and put in a resistance, ring a bell, or do any other work required. A small screw enables the instrument to be set for any current which the size of the wire on the coil allows. A touch of the finger, or a mechanical arrangement to act after a few moments, restores the connection when it is broken. In fixing the instruments the only precaution needful is to level them; they will then remain in perfect order for years. Little or no electric energy is consumed or lost by the apparatus, and, as will be seen, it can be set by index so as to act at any desired point of danger. For ship lighting a special form has been devised in which a spring is substituted for the action of gravity. The cups which contain the mercury, and one connecting bar and terminal, are cast solid out of copper and the arms which dip into the cup are arranged so as to

prevent any possibility of spilling the mercury. The base of the cut-out is made of slate. We understand that these instruments are in quite extensive use in England.

Annual Meeting of the American Institute of Electrical Engineers.

The meeting of the Institute for the election of its officers and the transaction of general business was held at the house of the Civil Engineers, this city, on May 15. There was a good attendance. The president appointed Messrs. Wheeler, Terry and Mailloux as a nominating committee. The secretary then read the following report, which was accepted :

SECRETARY'S REPORT.

With the close of the fourth year of the existence of the Institute, your secretary takes pleasure in announcing that the work for which it was organized has been still more actively entered upon since the last annual meeting, and with exceedingly gratifying results. Believing that its past record was of sufficient importance and interest to warrant more general support from all who were interested in electrical science, it was deemed proper that efforts should be made to enlist the aid of all who appreciated the value of such an organization. This policy has been beneficial in various ways. It has made known the existence of the Institute, and gained for it a world-wide reputation. It has enlisted the support of new adherents, and stimulated the attachment of those who were previously associated with it. The additional revenue thus derived has enabled the council to carry out various plans for the general good, and increased the value of membership to distant as well as local friends.

The plan of holding more frequent meetings, undertaken last year, has been continued more systematically, and all have been well attended. The value of the papers presented, and the discussions which followed, are familiar to all by reason of their monthly publication and distribution. The transactions of the Institute have also been very generally printed by electrical journals at home and abroad. In order to add to the value of the Institute's publications, a classified index was begun in December of all articles of importance on electricity, appearing in technical journals, published in the English language. This index is appended every month to the issue of the Transactions. Some idea of its scope and of the work involved may be formed when it is stated that the index during its first six months of compilation has included under the various heads upwards of 2,500 distinct articles, for which have been given nearly 4,000 references, accompanied by over 500 explanatory and critical notes. The immediate appreciation of this work on every hand is a sufficient warrant and reward for its execution. Such an index, if existing to-day, of early periodical literature on electricity would be simply invaluable, as those who have occasion to make searches or are investigating in any branch can testify; and the secretary believes that by assuming the task at this time the Institute will be found in a very few years to have done a work of inestimable importance. It is now proposed to extend the index so as to include all electrical books as they appear. The bibliography of electricity will then be rendered complete.

The Institute has doubled its numerical strength since the last annual meeting, besides reclaiming a good percentage of original members who had become lukewarm in their support. The increased revenue has been devoted to such purposes as would result in satisfying every member that he was receiving a fair equivalent for his share of the amount expended.

The project of providing permanent quarters which has been referred to in three previous annual reports, has been given careful consideration during the past year by the Council and its committee, as well as by the officers individually. Although greater progress might have been made, at the risk of abandoning the more important work of the Institute, it was deemed wise to continue for the present upon the line of policy which is now being pursued. The business affairs of the Institute and its accumulating literature made it necessary, however, that office quarters should be secured, and a suitable room has been leased and furnished for this purpose in Temple Court, No. 5 Beekman street.

The cordial relations which have existed since its organization between the Institute and the American Society of Civil Engineers still continue, and the meetings of the Institute will be held at the house of the latter, by courtesy of the Board of Managers, during the coming year, at the discretion of Council.

There have been 182 associate members elected during the past year, of whom 166 have qualified by paying their entrance fees and annual dues. Four have resigned, one has been died, one has dropped from the roll and one placed upon the suspended list. The total number of members and associates is 322, of whom 267 have paid up in full to date, seven are in arrears for the present year, twelve for two years, and thirty-six for three years. There has been an improvement in the delinquent list, by the collection of $387.50 during the year, but many of those who remain upon it have lost all interest in the work of the Institute. Others have met with financial difficulties which may yet be overcome.

The secretary takes pleasure in acknowledging the receipt of the following gifts from friends of the Institute:

From Mr. Edward P. Thompson a carpet for the office of the Institute.

From Mr. T. C. Martin $25 cash toward furnishing the same.

From Mr. Charles Colné a set of Patent Office Reports.

From the Consolidated Telegraph and Electrical Subway Company, a bound volume of photographic views of the subways as constructed in New York City.

From Mr. Emile Berliner a working model of his "Molecularium."

From Mr. Wm. H. Sawyer, files of the London *Electrician*, London *Electrical Review* and New York *Electrician* and *Electrical Engineer*.

RALPH W. POPE, Secretary.

Reports were then presented and accepted from Capt. Michaelis, of the committee on wire gauge, and from Mr. Geo. M. Phelps, Jr., of the committee on permanent quarters. The treasurer's report was presented, and Mr. G. A. Hamilton and Mr. F. W. Jones were appointed an auditing committee to examine the same. An invitation was accepted from the Electric Club to visit the Club House and examine the Edison improved phonograph on view there. The "nominating committee" then made its report of nominees to fill vacancies as follows: For president, Edward Weston ; for vice-presidents, Elihu Thomson, F. R. Upton and T. C. Martin ; for managers, Charles Cuttriss, Geo. B. Prescott, Jr., Wm. Maver, Jr., and T. D. Lockwood ; for secretary, R. W. Pope ; for treasurer, Geo. M. Phelps, Jr. On motion of Capt. Michaelis, duly seconded, the secretary of the Institute was authorized to cast the ballot of the meeting for the gentlemen nominated. Messrs. Van Size and Thompson, acting as tellers, received the ballot, and the gentlemen nominated were declared duly and unanimously elected for the respective vacancies.

A discussion ensued as to the desirability of changing the constitution affecting membership, methods of election, etc.

The auditing committee reported that it had examined the reports of the treasurer and secretary, as submitted, and found them correct, showing receipts of $3,771.02 and expenditures of $3,368.58. The report was accepted and filed. On motion the meeting then adjourned.

The general meeting of the Institute began at 10:30 A. M. on Wednesday, May 16. Owing to sickness Mr. Edward Weston, the newly elected president, was not able to attend until midday. Prof. Anthony was called to the chair, and a paper was read by Mr. P. B. Delany on "The Protection of the Human Body from Dangerous Currents." This was followed by a paper from Mr. F. B. Crocker on "The Possibilities and Limitations of Chemical Generators of Electricity." The next paper was read by Prof. E. L. Nichols, of Cornell University, on "Compensated Resistance Standards." After discussion, adjournment was taken for one hour for lunch.

THE LATE GEORGE M. PHELPS.

At the beginning of the afternoon session, after lunch, Mr. Edward Weston, the new president, was introduced to the meeting by his predecessor, who remarked that while the membership of the Institute was world-wide, the reputation of Mr. Weston as an electrical engineer was co-extensive with it Mr. Weston was very warmly received, but his illness was such as to forbid his remaining long, and the duties of chairman were ably discharged throughout a large part of the afternoon by Mr. F. R. Upton. The first paper of the afternoon was that by Mr. Nikola Tesla on "A New System of Alternate Current Motors and Transformers." This was accompanied by many drawings on the blackboard, and by the exhibition of two small motors. Prof. G. W. Plympton, of the Brooklyn Subway Board, then presented a paper on the "Underground Electrical Systems of Europe and America." This paper was accompanied by the exhibition of a large number of photographs collected by Prof. Plympton while in Europe, showing the various poles, housetop fixtures, etc., in use in such cities as Brussels, Antwerp, Milan, Paris, Berlin and elsewhere. This was followed by a paper by Mr. Geo. H. Stockbridge on "The Patent Court, and Uniformity in Patent Practice," to which succeeded a paper read by Prof. E. L. Nichols, from his assistant, Prof. Moler, on "The Moler Swinging Arm Galvanometer." The reading of this paper closed the regular business of a very pleasant and instructive day. The attendance was large.

The Electric Train Signal Company, of Chicago, has been incorporated by C. S. Owen and others, with a capital stock of $100,000.

The Death of George M. Phelps, Sr.

It is with deep regret that we announce the death of Mr. George M. Phelps, Sr., the distinguished inventor and instrument maker, at his residence in Brooklyn on May 18. Mr. Phelps, who was born at Watervliet, N. Y., March 19, 1820, began his career in the establishment at Troy of his uncle, a manufacturer of mathematical instruments, and in 1852 he became interested in telegraphic machinery, in which branch of work, perhaps more than in any other, he found the opportunities for the display of his marked genius as an inventor and designer. Many of the old House telegraph instruments were made under his direction, and to him the Hughes printing telegraph owed some of the features most essential to its use and efficiency. In 1859 Mr. Phelps brought out his celebrated "combination printer," described by Reid's *Telegraph in America* as "an instrument which has been without a competitor as the most successful printing telegraph in the world." This was again improved upon at a later period in the Phelps printer, now employed by the Western Union Telegraph Company. Mr. Phelps also did some highly original and important work in connection with the familiar "stock ticker," which from the first included in its mechanism many of his ideas and improvements. It has been well said of his work, "Whatever he touches he beautifies," his efforts being always directed with success to the refinement and simplification of the apparatus. It may be added that Mr. Phelps brought out also numerous inventions in paper-making machinery, bank locks, time regulators, electric motors, etc.

In 1856, Mr. Phelps became superintendent of the mechanical department of the American Telegraph Company, and his services were subsequently transferred to its successor, the Western Union Telegraph Company, in the same capacity. First at Troy, then at Williamsburg, and finally in New York, he gave to the work a supervision which resulted in a product unexcelled for elegance and finish, as well as durability. The late President Orton was a frequent visitor to the factory, and between him and Mr. Phelps grew up much more than an official intimacy. In the autumn of 1881, Mr. Phelps had a stroke of paralysis, when he was compelled to take a respite from business of several weeks. In 1884 he relinquished work altogether, even that which had since 1879 been his special care and delight, the conduct of experiments and the inspection of apparatus. From that time until the present month his strength gradually declined, until the end came last week, when paralysis suddenly attacked the lungs and throat. He died without pain and retained consciousness to the end. His interest in electrical matters to the last was evidenced by his action lately in becoming a life member of the American Institute of Electrical Engineers, of which his only son, Mr. George M. Phelps, Jr., the editor of *The Electrical Engineer*, is the treasurer. The funeral services were held in Brooklyn last Sunday, and the interment took place at Troy.

A Michigan Telegraph Line.

The following comes from Detroit :

There has grown up among the farmers of Lenawee County, in this State, a telegraph system which is quite unique in its character, and which might be profitably and generally extended throughout the rural districts everywhere. The system began by two farmers connecting their houses with a wire for their own private convenience, and operating their line with the ordinary Morse instruments. Gradually other farmers extended the line into their houses, and after a time the wire was run to the neighboring village of Tecumseh. Seven years ago the combined farmers and a few village merchants organized themselves into a company, and it has since been extended until now it has 65 miles of wire and 90 offices, two-thirds of the latter being in farmhouses, and nearly all the rest in stores where these farmers do their trading. One or two newspaper offices, as many more railroad freight offices, the County Telephone Exchange, and the larger Post Offices are all connected. Every farmer is his own operator, battery man, and line repairer. Of course any quantity of private communication is kept up between the stockholders of this independent system, and their connection with the village stores makes it easy to communicate their wishes as to purchases. As it happened, one farmer's life was saved by the wire. By accident he took a dose of poison, and no doctor was within several miles, but the wire was connected with the doctor's office in Tecumseh, and the farmer's daughter sprang to it and called up the physician. Having ascertained the kind of poison, the doctor telegraphed back to fill the patient with sweet milk until he got there.

From one of the railroad freight stations standard time is transmitted daily at 11 o'clock. When a piece of important news is received by the station officers, and at the newspaper office, some event of great national or State importance, it is sent over the farmers' lines, and by this means the farmers, who are regarded as slow and behind the times, are often several hours ahead of the reputedly faster denizens of the cities who are waiting for their afternoon papers to appear.

The Massachusetts Institute of Technology and its Influence Upon Electrical Progress.*

BY H. C. SPAULDING.

I propose this evening giving a brief sketch of the Massachusetts Institute of Technology, noticing its methods of instruction, and suggesting for discussion some of the results of technical education upon the scientific progress of the day. Humboldt has said "Whatever we wish to see introduced into the life of a nation must first be introduced into our schools," and it certainly seems as though Prof. William Barton Rogers must have been most thoroughly impressed by the truth of this idea when, in 1859, he began a public discussion of a scheme for technical education, to be associated on the one side with research and original investigation upon the largest scale, and on the other with agencies for the popular diffusion of useful knowledge. He succeeded in interesting some of the prominent citizens of Boston in this plan, but so entirely unfamiliar to the public mind of the day was the idea of technological instruction beyond the simplest requirements of civil engineering, that the Legislature of Massachusetts could not be brought to see the full merits of Professor Rogers' most comprehensive, and as all now view it, thoroughly practical plan, but enough was done by the Legislature during the few years following, to secure the chartering in 1861 and the actual inauguration in 1865 of the Massachusetts Institute of Technology, of which Professor Rogers became the first President, devoting to it all the varied wealth of his accomplishments and acquirements. (Mr. Spaulding here paid a high tribute to the memory of Professor Rogers, in founding the Institute.)

Professor Rogers entered upon this new enterprise with all the enthusiasm and ardor which had hitherto characterized his work, and the result was the granting of a charter by the Legislature of Massachusetts in an Act dated April 10, 1861, for the founding of the Massachusetts Institute of Technology. Of the three integral parts of the Institute, the Society of Arts was first organized, and has continued ever since to hold semi-monthly meetings from October to May of each year. The School of Industrial Science was opened in February, 1865, in temporary rooms in the Mercantile building, Sumner street, Boston, with 27 pupils, of whom 14 graduated with the diploma of the Institute of Technology. Less formal action has been taken for carrying out the purpose of the founders of the Institute in the establishment of a Museum of Arts. Varied and valuable collections have been made, which, taken together, would constitute no inconsiderable foundation for such a museum, but thus far this material has been subdivided, so that the portions especially related to individual departments of study and research might be placed within the easy reach of the students and teachers respectively concerned therewith.

The buildings now occupied are, 1st, the Rogers Building, on Boylston street, devoted to the engineering departments and to the instruction in mathematics, mechanics, literature, history, political science, geology, mineralogy and physiology; 2d, the new building sometimes called the Kidder, corner of Boylston and Clarendon streets, mainly devoted to the departments of chemistry, physics, civil engineering and architecture and to instruction in languages; 3d, a series of laboratories, drawing and recitation rooms, at the foot of Garrison street, mainly devoted to work in the mechanic arts and to the instruction of the Mechanic Arts' School and the Lowell School of Design; 4th, the gymnasium and drill hall on Exeter street.

The running expenses are defrayed by the tuition fees received, aided by private contributions and also by an income derived from land granted by the State, in consequence of which the Institute is obliged to include military drill among its exercises. An additional grant of $200,000 has been recently given by the legislature.

In instruction, great weight is given to practical work, part of the day being devoted to recitations and lectures, and the balance to laboratory exercise. Each of the different courses has a separate and well equipped laboratory, fitted for original investigation, which is at all times open to the students of the respective classes, and in which they are expected to spend more or less time in addition to that required in the printed schedule.

To quote again from Humboldt, "the time is not far distant when science and manipulative skill must be joined together," and apparently this is realized by those responsible for the arrangement of exercises as evidenced by a glance at the week's programme for any one of the different courses. In using the word "laboratory" I include not only what would strictly come under this heading, but also the work-shops and drawing rooms. Visitors are often surprised and amused at the transformation after seeing several rather dudesque young men enter the outer door and appear only a few moments later in flannel shirts and leather aprons ready for two or three hours at the anvil or forge, or prepared for work in the mining laboratory. The mode of operation here is rather different from that in vogue in some institutions where the assistants do all the work and the students look on making comments and taking notes of the operations. In the Institute every man is obliged to go into matters for himself, dirt and such minor disadvantages being considered of no importance. The estimation of time, too, is considered of little moment, especially in the case of advanced students, as it is a common saying among the boys that in order to meet the entire approbation of their own and their teachers' consciences they must study till three o'clock in the morning and then get up at midnight and begin again. I recall with pleasure not entirely unmixed however with other sentiments, several cold winter mornings, when, with other poor wretches, I reported for duty at the Institute buildings at 6 A. M.; seven or eight of us were on for a boiler test, which necessitates being on hand at this unearthly hour.

In these boiler tests, different stations are allotted to each student, as for instance, weighing the coal, weighing feed water, weighing ashes, etc., the data, as to steam pressure, temperature of feed water, etc., are recorded every five minutes during a ten-hour run, and calorimeter tests are made two or three times during the day to determine the quality of the steam. Great care is taken that the conditions of the boiler at beginning and ending the tests shall be as nearly similar as possible. Toward this end the fires are drawn at about five minutes before the time of beginning and the steam pressure brought to the average point, the level of the water being also noted. At the given signal, a known quantity of fuel is put on the grate and the fire started. At the end of the test, the boiler being as nearly as possible in the same condition as above, the fires are drawn again and the exact weight of the fuel, thus removed, deducted from that used in firing during the day. I think this method of carrying on the test will for the actual value of its results compare favorably with that recently proposed by a prominent educational gentleman in New England, who advocated using a small boiler upon platform scales for this purpose.

During the past year quite an amount of interesting work has been done in the electrical laboratory, including electrical and mechanical tests of some different makes of motors, also upon the efficiency of the Westinghouse converter. A new method has been used for testing the converters, which requires no measurements not obtainable with an alternating current. Tests have been made upon incandescent lamps of different makes, including the customary ones upon life and efficiency and also upon the rise of candle-power with increased voltage, and it is expected that the results of this latter line of work will be shortly in condition for publication. The specific inductive capacity of different materials has also been investigated with some very curious results. Different makes of storage batteries have also been tested and compared. Some curious experiments have been tried in the way of arrangements of apparatus: in one case, two arc dynamos, three constant potential dynamos, and three different makes of storage batteries being run in series on the same circuit. A rather unusual combination was used on the occasion of Professor Anthony's recent address, owing to the location of some machinery which it was desired not to change on that occasion. The Porter-Allen engine in the basement of the Rogers building ran an Edison 110 volt dynamo in the other building off a shaft passing between the two. This, in turn, drove a Weston 80 volt dynamo as a motor which was worked up to 110 volts for this occasion, and this in its turn was belted to an alternating machine which furnished the current for Professor Anthony's experiments. The efficiency of the system is not stated.

* Abstract of paper read before the Boston Electric Club, May 16, 1888.

In Favor of the United States Company.

In the suit of the Edison Electric Light Company vs. the United States Electric Lighting Company, in the U. S. Circuit Court for the Southern District of New York, Judge Wallace has handed down the following opinion sustaining defendant's plea that it should not be required to answer.

The plea to the bill of complainant, which has been set down for argument, alleges in substance that the defendant should not be compelled to answer, because by reason of facts averred in the plea the remedy of the complainant is plain, adequate and complete at law, and this court should not take cognizance in equity of the suit.

The bill alleges the infringement by the defendant of letters patent of the United States, No. 263,140, dated Aug. 22, 1882, granted to the complainant upon the application of Edison for an improvement in dynamo-electric machines, the invention of Edison. The bill shows that Edison made his application for a patent Aug. 9, 1880, and assigned his title to the complainant June 21, 1881. Besides the averments usually contained in bills to restrain infringement of patents, allegations are introduced by way of anticipation of the supposed defense to the bill in order to meet any issue tendered by the defendants. These averments are in substance that the defendant may wrongfully pretend as an excuse for its wrongful acts in the premises that the complainant's letters patent are no longer in force or operative, because at the time they were granted the invention described therein had been first patented in the Austro-Hungarian Empire for the term of one year, and that such foreign patent has expired, and consequently the term of complainant's patent has expired; but that the facts are that Edison at the time of making the invention was and always since has been a resident and citizen of the United States, and made, perfected and reduced the invention to practice in the United States, and made and filed his application for a patent in the United States Patent Office Aug. 9, 1880, and prior to any application made by him abroad, and that in order to protect his invention in foreign countries it was necessary that he should promptly apply for letters patent abroad, and the issue of the foreign patent preceded the United States patent solely because of the greater diligence and more prompt procedure of the foreign administration. The bill further avers that the letters patent of the Austro-Hungarian Empire were granted for the term of fifteen years from their date, and are in full force and effect.

The plea alleges that prior to the beginning of the complainant's letters patent the invention or discovery described and claimed therein had been patented by Edison, or with his knowledge, consent and procurement, by a public patent of the Austro-Hungarian Empire, granted to Edison July 21, 1881; that the term for which the foreign patent was granted was one year from its date, and expired on the 21st day of July, 1882; that subsequently, by grant made on the 19th day of July, 1882, the foreign patent was extended for a new term of one year, and the extended term expired on the 21st day of July, 1883; and that the extended Austro-Hungarian patent was existing and unexpired when the complainant's letters patent were granted, but the term thereof expired July 21, 1883, and before the commencement of this suit. The plea denies the averments of the bill that the Austro-Hungarian patent was granted for the term of 15 years, and was in full force and effect when this suit was brought.

If the complainant's patent had expired before the bringing of this suit, it is plain that a court of equity has no jurisdiction of the cause of action for infringement, and the complainant can only proceed by a suit at law for the recovery of damages (Root *vs.* Railway Co., 105 U. S., 189).

It is contended for the complainant that such a defense cannot be raised by a plea, and if it could, that the present is insufficient both in matters of form and substance to present such a defense.

One of the uses of a plea in suits at law or in chancery is to object to the jurisdiction of the court (Livingston *vs.* Story, 11 Pet., 351; Wickliffe *vs.* Owing, 17 Howd., 47, 51). In a case where it was urged that the sum involved was not of sufficient amount to order a court of chancery to take cognizance of the cause, Chancellor Walworth said: "If that fact did not appear on the face of the bill, it might undoubtedly have been pleaded in bar of relief" (Smets *vs.* Williams, 4 Paige, 364).

In Beames on Pleas, 55, it is stated: "Those pleas which are commonly called pleas to jurisdiction do not proceed the length of disputing the right of a plaintiff in the subject of the suit, or allege any disability on the part of the plaintiff to prosecute the suit, but simply assert that a court of chancery is not the proper court to take cognizance of those rights." The present plea falls within this definition.

There is no force in the objection that the plea is a negative plea. Such pleas are sanctioned and are now frequently resorted to. A familiar instance is a plea denying partnership where the bill prays an account of partnership transactions.

The present plea is not strictly a negative plea. It is a negative plea so far as it denies the averments of the bill that the term of the Austro-Hungarian patent is for fifteen years and that the patent was in full force when the suit was brought. It is an affirmative plea as to all the other facts which it sets forth. The effect of the plea is to admit all the facts alleged in the bill except those specifically denied, and to meet the case made by the bill by alleging the new facts intended to show that the complainant's patent had expired at the commencement of the suit. If the bill did not contain the anticipatory averments which have been inserted in it the denial in the plea would have been unnecessary. With this denial in the plea it is only necessary to inquire whether the facts set up affirmatively are a defense to the suit, admitting that everything in the bill not denied is true.

A pleading is sufficient which sets forth documents according to their tenor or legal effect, and avers the substantive facts relied on as a cause of action or defense. Tested by this rule, the plea is sufficient in form without making a profert of the Austro-Hungarian patent, or setting out in detail any of the evidential facts to show that it was a valid grant of letters patent for the invention for the term of one year. If issue were taken on the plea, it would only be necessary for the defendant to produce a properly authenticated copy of the foreign patent and show the seal or signature affixed to it to be the act of an officer duly authorized to issue patents. The effect and operation of the patent is to be determined as a question of law by the terms of the document, unless evidence of the foreign law is introduced to qualify or controvert the construction which would otherwise be placed upon the instrument. It is not necessary in a pleading to allege that an instrument was executed by an agent and that the agent was duly authorized thereto, it is sufficient to allege its execution by the principal. Delafield *vs.* Kinney, 24 Wend., 345. The tribunals of every nation take judicial notice of the public seals of sovereign states (1 Greenleaf Ev., Sec. 4); and the annexation of the seal will be presumed to have been made by a person having custody thereof and competent to do the act (Phillips Ev., 419).

The plea sets forth a sufficient defense if the term of a United States patent ends at the same time the term of a foreign patent granted for the same invention ends, when it appears that the foreign patent was not applied for until after the domestic patent was applied for; that it was not applied for by the inventor himself, but by some other person by his procurement, and that the domestic patent was granted to one who at the time of the application was an American citizen and had made and reduced his invention to practice in this country. The question presented depends upon the meaning and effect of Section 4887 United States Revised Statues, which is as follows:

"No person shall be debarred from receiving a patent for his invention or discovery, nor shall any patent be declared invalid by reason of its having been first patented or caused to be patented in a foreign country, unless the same has been introduced into public use in the United States for more than two years prior to the application. But every patent granted for an invention which has been previously patented in a foreign country shall be so limited as to expire at the same time with the foreign patent, or, if there be more than one, at the same time with the one having the shortest term, and in no case shall it be in force more than seventeen years."

It is not at all material whether the foreign patent is granted to the inventor who makes the application in this country or to some other person to whom he has caused the invention to be patented; the statute expressly covers both cases. Nor is the fact of any importance that the inventor who makes the application in this country is one of our own citizens; because since the Act of July 4, 1836, which repealed all former patent laws and established a comprehensive code covering the whole subject, our laws have not made any distinction between our own citizens and foreigners in respect to the privilege of obtaining patents or the conditions and restrictions of the privilege granted, except as to the amount of the fee to be paid and the protection of inventions by caveat. The question may, therefore, be simplified by eliminating these immaterial ingredients; and the real inquiry is, whether the section limits the term of a domestic patent to the term of a foreign patent when the application for the foreign patent is not made until subsequent to the application in this country but the foreign patent issues before the domestic patent.

If it were proper to treat this question as an original one, it would be necessary first to inquire whether there is any ambiguity in the language of the statute. If there is not the duty of the court is to give effect to its obvious meaning, notwithstanding it may be thought to make an unreasonable and harsh innovation upon the pre-existing privileges of our own inventors. It is not only the safer course to adhere to the words of a statute construed in their ordinary import, instead of entering into any inquiry as to the supposed intention of Congress, but it is the imperative duty of the court to do so. Where the meaning of the revised statutes is plain the court cannot look to the sources of the revision to ascertain whether errors have or have not been committed by the revisers. (United States vs. Boyd, 100 U. S., 508.)

There is no practical difference in the phraseology of Section 4887, and that of Section 25 of the Act of July 8, 1870, from which the section is reproduced. The precise point now raised by the complainant, but made with reference to the effect of Section 25 of the Act of 1870, was considered by this court in The Gramme Electrical Company vs. The Arnoux & Hochhausen Electric Company, 21 Blatch., 360. It was insisted by the defendant in that case that the complainant's patent expired at the date of the expiration of an Austrian patent, and

the complainant took the position that the defense was not tenable because the application for his United States patent was filed before the application for the Austrian patent was made. It was held by Blatchford, J., that the date of the application for the United States patent could not affect the question, and that the meaning of the statute was that the United States patent should expire at the time of expiration of the foreign patent, irrespective of the time when the foreign patent was applied for.

Judge Blatchford adopted in that case the views of Judge Nixon upon the same question in Bate Refrigerating Company vs. Gillette, 13 Fed. Rep., 553. In the Bate case the question arose under Section 4,887, and it was contended that complainant's United States patent did not expire at the date of the expiration of a Canadian patent, because the application for his patent was filed antecedent to the application for the grant of the Canadian patent. The court was of the opinion that it would be wresting the language of the section from its plain and obvious meaning to sustain that position. These decisions have been followed by Bradley, J., upon a subsequent hearing in the Bate case, and by Colt, J., in the Bate Company vs. Hammond (First Circuit U. S.).

In view of these adjudications the question should not be considered as an original one. The plea is therefore allowed.

John C. Tomlinson, Richard N. Dyer, Wm. M. Evarts and Clarence A. Seward for the plaintiff.

Samuel A. Duncan, Leonard E. Curtis, Frederic H. Betts and Edmund Wetmore for the defendant.

Protection of the Human Body from Dangerous Currents.*

BY PATRICK B. DELANY.

Since the object of reading a paper before this society should be the enlightenment of members on the subject under consideration by the presentation of facts developed by experimentation or of theories supported by a reasonable amount of investigation, I must apologize for my delinquency in both respects, and trust to the kind indulgence of the society in making a few suggestions with a view of eliciting information and opinions from those whose experience and familiarity with the subject enables them to speak with authority.

I allude to what are considered dangerous currents and their effect on the human body. That there is danger in handling conductors conveying high tension currents must be generally admitted. The question, therefore, is, can fatal results from such currents be wholly or partially averted? All will agree that with proper care on the part of the companies and intelligent co-operation on the part of employés, but little would be heard of the danger of electric currents. But companies are economical and employés are careless. Familiarity with danger breeds contempt for it. This is exemplified almost daily in every department of industry. A new man in a powder mill will exercise the greatest care and observe all the rules of the establishment faithfully. In a few months the same man will smoke a pipe over an open powder keg.

Protection is necessary principally for those who through carelessness or ignorance fail to protect themselves. It has been claimed that there can be no such thing as an accident—that nature has none, and that all so-called accidents are simply the results of miscalculation, bad judgment or carelessness. But it must be remembered that the vigilance of the most alert will sometimes relax, and this to them is the moment of danger.

Realizing that something should be done to protect dynamo men and wire handlers from injury from powerful currents, I, a few years since, invented a device for shunting the vital parts of the body. Partly on account of a pressure of business in other branches of electricity, but principally owing to a hesitancy in bringing out a device about the efficacy of which there seemed to be some doubt, its introduction to scientific criticism was delayed until a few weeks ago. As the references made to the question in the electrical papers have failed to elicit an expression of opinion satisfactory to any degree, it has been deemed advisable to bring the subject before this meeting.

The question to be determined is, to what extent a wire of practically no resistance, extending from one wrist to the other and bound around the wrists in numerous convolutions, so as to make good, but not uncomfortable, contact, will protect the vital parts of the body from fatal injury when it is placed in the path of a dangerous current through contact at the hands. It is claimed by some that the current having once entered the muscles, veins and tissue at the hands, will not leave the arms at the wrists and follow the shorter path of the wire, but will confine its course to the arms and body alone. The other opinion is that the greater portion of the current received at the hands will leave the arms at the wrists and follow the wire. The problem seems a difficult one to solve. So much depends on the condition of the person at the time of receiving a shock, a large number of tests would be necessary to arrive at results which would afford a safe basis for calculation. A few years ago Dr. Stone, connected with one of the London hospitals, made a series of interesting experiments upon patients afflicted with various ailments, with a view of determining whether or not fluctuation in their physical condition affected the electrical conductivity or resistance of their bodies. The results proved, according to my recollection, that great changes took place in the electrical resistance of the patients experimented upon from day to day, and that there was a direct influence manifested by the rise and fall of diff rent diseases upon the electrical conductivity of the body as a whole or in part. An account of Dr. Stone's experiments was published in *Nature* at the time. But while the experiments are most valuable for the purpose for which they were intended, they throw but little light on the subject of dangerous currents and protection from fatal injury.

Last September there was published in the *Electrical Review* of London, a paper on "Shocks from Alternating Currents," by Mr. G. L. Addenbrooke, who for some time previous had charge of the Grosvenor Gallery installation, where a primary current of 2,500 volts was constantly employed. While no one had ever come in contact with both mains at once, the writer stated that even if such an accident had happened he was "by no means prepared to assert that the result would undoubtedly be fatal." "Indeed," says he, "I rather incline to the opinion that if the subject of the shock were healthy, and the circumstances under which he received it were favorable, the chances are he would survive."

I cannot make out what Mr. Addenbrooke means by receiving 2,500 volts under favorable circumstances. It seems to me, if they are received at all, the circumstance could not be other than unfavorable. Mr. Addenbrooke himself received a severe shock, and as he speaks from experience, I quote his account of how it affected him: "The primary effect of the passage of the current through the body is, of course, to contract the muscles. The amount and persistence of this contraction depend on the quantity of the current flowing, or, as it is usually designated, *the intensity* of the shock, and varies from a simple twitching of the limbs to complete and intense contraction or rigor of apparently every muscle in the body. In this latter case, the current completely supersedes the action of the mind over everything capable of contraction or movement. Consciousness, however, is apparently rarely, if ever, lost, though the subject may be entirely unable to make any motion, cry out, or do anything to help himself. If aid is not near, such a state may be maintained for some time. On release from such a position by extraneous or natural causes, the subject is usually dazed, but if at all unconscious, soon recovers completely and experiences no further functional disturbance than the debility and nervousness naturally following such a severe strain on the system." While admitting that fatal shocks are possible, this gentleman gives it as his opinion that "if the shock is not sufficient to cause instantaneous collapse, apparently the body can bear the strain of the continued passage of the current for some time," and that death is caused by paralysis of the involuntary muscles controlling the heart and lungs, and that the preliminary stages of total collapse are analagous to what occurs when drowning." Referring to the local action of the current on the body where it enters and leaves, this writer also says: "If the contact is good, that is, if it consists of a good area, say of over a couple of square inches of a fairly moist skin pressed with moderate firmness against a metallic body or other good conductor, no visible injury may result. For instance, a man will often get burnt about the hands, but his feet, by which the current leaves, will be unaffected, or only slightly reddened or inflamed. Burning of the hands or other parts of the body will occur when there is imperfect contact of the body with the conductor, coming in contact with a bad or semi-conductor, such as a dirty or carbonized surface. The burning is caused by the absolute setting up of an arc."

It seems to me this gentleman's views, based, as we are led to believe, on actual experience, are somewhat paradoxical. And surely numerous cases of deaths from currents recently disprove many of Mr. Addenbrooke's deductions. True, nothing short of death is made public, so that there is but little information to go upon relating to the instances which must be of frequent occurrence where men are *almost* killed by electric shocks. In all cases that have come to light, whether simply injuries or cases of death, the parts of the body coming in contact with the current have been badly burned. The unfortunate "Trouble Hunter," who lost his life a few days since, was not only burned at the hands but at the knees. In cases where the shock is not instantly fatal, may it not be that the burning of the flesh at the points of contact is so great as to destroy to a considerable extent the conducting substance in contact with the wire, and thereby cause a fall in the current passing through the body? It is certainly owing to the fact of the body being a very poor conductor that harm is done. If it offered no resistance there would be no realization that a current was passing through it. An arc would be created at the point of contact, provided the contact was *imperfect*, but the body itself would be uninjured. It seems to me that the human body must be viewed as any other semi-conductor, with the exception perhaps of susceptibility to greater change under the continued action of a current owing to the fluids which it contains. It is owing to its resistance that a carbon filament becomes incandescent.

The carbon rod of an electric lamp is not consumed except at the point where the arc is formed by the resistance of attenuated particles under combustion. Any conducting substance placed in the path of more current than it is capable of conveying must be heated, consumed or decomposed, according to its nature and in proportion to the discrepancy between the conducting capacity of the conductor and the sum of the current.

Now if we liken the human body from hand to hand to a canvas hose or tube filled with water and which allows a certain quantity of moisture to ooze through the surface, corresponding to the moisture of the skin, and if this be inserted in a circuit, connection being made at the extreme ends, corresponding to the hands, and a shunt wire of minimum resistance be wound around the tube two or three inches from the ends, corresponding say to the wrists, we can, perhaps, more understandingly speculate on the action of a dangerous current on the human body, contact being made at the hands and the shunt wire encircling the wrists. It should be borne in mind that the contact between the shunt wire and wrists is much better than the contact at the hands, since the wrists are more tender than the hands. Now referring to the tube and assuming that the contacts at the ends have improved by reason of the currents eating its way into the water, does it not follow that the current instead of following the entire length of the tube of water, offering, say thirty times the resistance of the two or three inches of water from the end of the tube to the shunt wire, and several thousand times the resistance of the shunt wire itself, will, to a great extent, pass from the tube to the shunt wire and in its passage *improve* the contact at that point as it did at the ends in entering the tube? I have often noticed that upon receiving a shock of 150 to 250 volts profuse perspiration instantly followed. This would greatly improve the contact at the wrists above the normal, so that it would seem impossible that the current should confine itself to the fluids and muscles of the body in preference to the wire when separated from the wire only by thin, tender skin filled with moisture.

In considering the danger point of currents it seems reasonable to recognize the same law, or rather recognize the absence of any law, governing other destructive agencies. Let it be concussion, strain, asphyxia, poison, or other enemy of endurance, there are hardly two cases alike. One man may emerge with but slight injury from a cause which to another man would be death. Why should it not be so in the matter of electric shock? Death, of course, must be the consequence of a certain degree of cause. If 2,000 volts are necessary to kill in any instance, one volt less would avert death, while shunting 100 or 500 volts would leave a proportionate margin of safety. Fatal results through the medium of electricity do not come by jumps any more than by any other force or element of destruction. There is in this subtle agency, as in all others, a last straw which breaks the camel's back—a last volt which does the final harm. Hence the importance of protecting, as far as possible, those exposed to this danger.

Regarding the immediate cause of death or the effect of currents on the substances of the body, we must look to the medical men for light. Probably all subjected to shock might not be similarly affected. In one case it might be the heart, in another the brain, and in others the lungs that might be injured. Why not have a thorough investigation of this subject, and then perhaps wire handlers may be subjected to an examination before they are allowed to engage in such work, just as men are examined for various other duties.

There seems to be so little known about these matters, I shall feel gratified if this paper serves as even a feeble incitement to discussion and investigation, as I can concieve of no subject offering a more humane incentive.

* Read before the American Institute of Electrical Engineers, May 16, 1888.

Underground Electrical Conductors in Europe and America.*

BY PROF. G. W. PLYMPTON.

The problems of construction of underground systems of electrical conduction will have been solved when the telephone and the arc light systems are both buried under our streets without impairing the efficiency or durability of either.

By this I mean that all the difficulties encountered in burying conductors are involved in converting telephone and arc light from *aerial* to *underground* systems. Telegraph lines and systems of incandescent lighting present fewer difficulties in the process of burying, and none of a kind not met with in dealing with the systems first mentioned.

The telephone problem is substantially solved. Some details only remain to be settled, among which may be mentioned the best size of conductor, the most serviceable insulation and the maximum distance of effective service for either grounded or metallic circuits.

In Brooklyn the general plan adopted is that of a conduit divided into ducts through which cables containing from sixty to one hundred wires are drawn. The material of the conduit is for the most part creosotod wood. About ten miles of this is already in use in our city, and about four and a half miles of the Dorsett concrete conduit. For the extensions of the underground systems for the present year, only creosoted timber is to be used.

Among the lessons learned from our experience are: 1st. That in creosoted conduits the use of cables covered with kerite, or any similar rubber or gutta percha compound, must be avoided. 2d. That in the so-called lead covered cables, the use of pure lead is also to be avoided, as it is slowly converted into a porous and friable lead carbonate. An alloy of lead with five or six per cent. of tin seems to resist the destructive action. 3d. That the conducting wire first used is too small for satisfactory telephone service. The difficulties of induction and retardation led to complaints as soon as 4,000 or 5,000 feet of underground wire was put in service. The cables that are now being put in are made up of wires whose cross section is greater by one-third than that of the first wire, and they are protected by twice the thickness of insulation.

I mention the above conclusions as having been drawn from our own experience in Brooklyn.

In commencing our work we gathered such information as could be gleaned from localities where solutions of the problem had already been attempted. The impression so largely prevailed that in Europe all telephone and telegraph conductors were underground that our Board decided that a personal inspection of European systems should be made by one of our number. The duty devolved upon me. The result of my inquiry has been published in the scientific papers.

I will briefly refer to a few of the incidents. (Professor Plympton here gave an epitome of the third annual report of Brooklyn Subway Commission, which embodied his observations).

In regard to the burial of the arc light wires I can only say that no method yet tried seems certain of success. Most of them certainly insure the destruction of the underground conductors in from one to three years. But I have no doubt that a solution of the problem will soon be reached, although the system will be kept apart from the telephone and telegraph subway.

It does not seem likely that arc light conductors will be allowed in the same conduit with telephone wires, nor will they be distributed from the same manholes.

In saying that, I believe that a solution of the problem will soon be found. I do not mean to assert that casualties like that recently recorded of a man in the Bowery, who lost his life by grasping the naked wire close to an arc lamp, can be prevented by any system of burying wires. To prevent such *accidents* (if that is the term to be used) the arc lights must be buried with the wires.

All past experience teaches us to proceed cautiously. Nothing can now permanently check the growth of the telephone, the telegraph or the electric light. They have become necessities of our civilization, and any hasty or ill-advised enforcement of the law to convert all aerial to underground systems which should result in serious injury to them, would prove the surest way to perpetuate the nuisances of overhead wires and poles in the streets.

* Read before the American Institute of Electrical Engineers, May 16, 1888.

A "Slap Dash" Rule for Wiring.

To the Editor of The Electrical World:

SIR: I should like to present for the consideration of the motor fraternity the following "Slap Dash" rule for wiring. For a 400 volt circuit, $D \times H = Cm$, or number of horse-power to be transmitted, multipled by the distance in feet, equals area of wire in circular mils. For 600 volts divide by 2. For 220, multiply by $\frac{1}{2}$, and for 110 by $\frac{1}{4}$. I will not say anything concerning the derivation of the above, but if any of your readers have any objections to it, or can offer a more convenient and reliable rule, I should be glad to hear from them. H. C. SPAULDING.

BOSTON, Mass.

A Swinging Arm Galvanometer.*

BY PROF. GEORGE S. MOLER, A. B., B. M. E., CORNELL UNIVERSITY.

The objects sought in the construction of this galvanometer were applicability to a great range of currents, accuracy of indication and portability. In passing from the measurement of large to that of small currents no change in the apparatus is necessary, and still throughout a wide range great sensitiveness is maintained.

These ends are attained by making use of the fact that the influence of a current on the magnetic needle varies with change of distance and with the angle which the plane of the coil makes with the horizon. The principles of the sliding coil galvanometer and of Obach's cosine galvanometer are thus combined. A movable arm is hinged to the base of the galvanometer, Fig. 1, and carries the coil, which is attached to its outer end. The length of the arm is such that in the vertical plane the needle will be in the axis of the coil. By means of screw clamps, the hinges are made to produce friction enough to hold the arm in any required position.

When the coil is brought up into the vertical plane it is very near the needle and a small current will produce a deflection. In this position, which is that of maximum sensitiveness—(since the distance is a minimum and the angle which the coil makes with the horizontal plane is 90°)—$\frac{1}{100}$th of an ampère produces a deflection of about 8 mm.

As the arm is carried down toward the horizontal position, greater and greater currents must be employed to produce the same effect. The position of the coil can be read upon a graduated quadrant which passes through it, there being a pointer attached to the coil and extending inward to the graduations.

The arm consists of two parallel bars of copper, terminating in the two hinges. These are insulated from each other, and from them two flexible conductors are carried to the extremity of the base: after that they are twisted together for a distance of about one meter and end in a block to which two large binding-posts are attached.

The coil is made of a copper rod 8.5 mm. thick, and its outside diameter is 76.5 mm. The radius of the graduated quadrant is 343 mm. and it is divided into twentieths of an inch. The radius of the lamp-scale is 381 mm. The scale forms the arc of a circle, having the galvanometer mirror for a centre. Its length is 500 mm., and it is composed of paper rendered semi-transparent by being treated with castor oil.

The needle is shown in Fig. 2. It is a bell-shaped magnet carrying a mirror, which can be rotated slightly upon the suspension rod for the sake of adjustment.

The needle is suspended by means of a fine silk fibre and is prevented from making a complete revolution by means of a stop. Its motions are damped in the usual manner by the action of a surrounding cylinder of copper.

The rays of light from a small gas lamp, shown in Fig. 1, after passing through a lens, are reflected from the mirror and then fall upon the scale. When the plane of the swinging coil is in the magnetic meridian and no current is flowing, the spot of light will fall at the centre of the scale. The lamp and scale are attached rigidly to the body of the instrument for the sake of rigidity and to avoid the necessity of repeated calibrations. In the lamp-

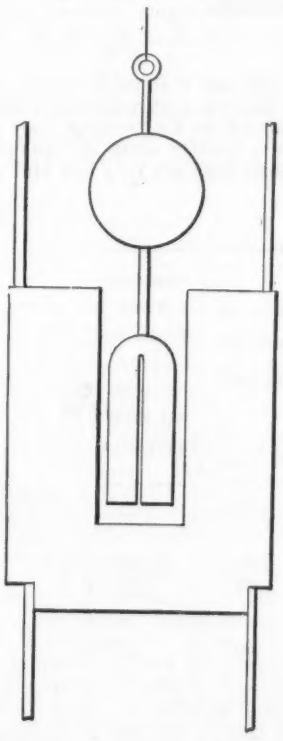


FIG. 2.—THE "MOLER" SWINGING ARM GALVANOMETER.

case is a small circular opening having a fine vertical cross-hair of platinum, and the lens is so placed that the image of the cross-hair is sharply defined upon the scale. All parts of the scale being equally distant from the mirror, as shown in Fig. 1, the definition of this image is equally good for all deflections.

The swinging-arm galvanometer is especially designed to be used with the method of constant deflections. By carrying the coil up from the horizontal position, the spot of light will be deflected more and more, until the image of the cross-hair is made to coincide with the chosen mark upon the scale; the position of the coil is then to be read and the current found by reference to a calibration curve or chart. In the measurement of feeble currents, the chosen point on the lamp-scale may be near the position of no deflection, while for stronger currents it may be further away. Several deflection points may be thus chosen and a calibration by means of some standard instrument can be made for each; then, to insure greater accuracy in the determination of a current, several of these points may be used, and the mean of the currents indicated by them may be taken, giving to each its proper weight.

*Read before the Amer. Inst. Elect. Eng., by Prof. E. L. Nichols, May 16.

The instrument may also be used by taking different fixed positions for the coil and reading the deflections of the spot of light, calibrating for each of these positions as before. These two methods may also be combined by moving the coil until the spot of light is approximately in coincidence with a selected deflection point, observing its distance from the same and applying to the current value, by means of the previously determined figure of merit, the proper correction. In this way changes in a slightly fluctuating current can be followed and measured by moving the coil.

In order to indicate heavy currents to an audience in a lecture-room it is only necessary to remove the lamp-stand and scale and to make use of the stronger light of the magic lantern, the image of a slit in the field of the lantern, after reflection from the galvanometer mirror,

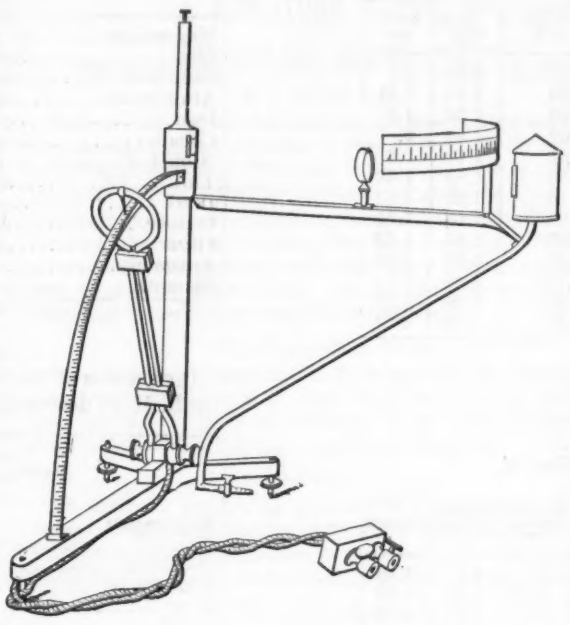


FIG. 1.—THE "MOLER" SWINGING ARM GALVANOMETER.

being thrown upon a wall or screen. A position of the coil can then instantly be found which will produce suitable deflections for any given current, from a fraction of one ampère up to that which the coil and connections can be made to convey without destruction from heating.

In the curve, Fig. 3, and the accompanying table are given the results of a calibration of a galvanometer of the pattern just described, which has just been constructed in the Department of Physics in Cornell University.

The deflection selected was 10 cm., and the measurements, which extended from 3 ampères to 60 ampères, by no means covered the possible range of the instrument. The movement of the coil indeed covered only 200 of the 400 scale divisions into which the reading quadrant is divided.

The calibrations were made in the magnetic observatory of the University, in which locality the average value of the earth's horizontal intensity is .1713. The currents were measured upon the great tangent galvanometer.

Simultaneous readings were made upon that instrument and upon the swinging-arm galvanometer.

The readings of the great galvanometer, reduced to ampères, with the corresponding positions of the swinging coil for a deflection of 10 cm. are given in the following table:

CALIBRATION OF THE SWINGING-ARM GALVANOMETER BETWEEN 5 AMPÈRES AND 60 AMPERES CONSTANT DEFLECTION = 10 CM.

Current in ampères (large galvanometer).	Quadrant readings (swinging-arm galvanometer.	Current in ampères (large galvanometer).	Quadrant readings (swinging-arm galvanometer.)
5.21	79.0	19.48	138.0
5.54	79.5	24.42	151.0
5.84	82.0	24.48	151.5
8.04	95.8	32.00	167.0
10.35	106.0	33.44	168.5
10.39	107.0	33.99	171.0
10.86	110.0	38.50	179.5
11.53	110.0	42.79	185.0
13.25	119.0	43.90	187.0
13.92	119.5	46.14	191.0
15.25	125.0	53.56	202.0
19.39	137.5	59.39	208.0

From these values, with the readings of the new galvanometer as abscissæ and currents in ampères as ordinates, the curve shown in Fig. 3 has been constructed.

From this curve the currents for intermediate positions of the coil may be determined and the degree of accuracy of which the instrument is capable may be estimated.

The Possibilities and Limitations of Chemical Generators of Electricity.*

BY FRANCIS B. CROCKER.

Electro-chemistry seems less generally and less clearly understood than any other branch of electricity of equal importance. The facts concerning the dynamo, motor, telegraph and telephone are widely and definitely known; but there are ideas, statements and claims in regard to batteries which are further from the truth, more prevalent and go longer without being contradicted than any other collection of errors that I can call to mind.

Primary batteries have not received the attention in this country that they have abroad, particularly in England, where the successful or unsuccessful attempt to float a new primary battery company is a matter of almost weekly occurrence. Nevertheless the subject is a sufficiently important one, and the false ideas of which I have spoken

*Read before the American Institute of Electrical Engineers, May 16.

have spread so far beyond the quacks, to whom such ideas are usually confined, that the subject deserves more study than it usually receives, particularly from the scientific standpoint.

Electromotive Force.—The electromotive force which a given battery or combination of materials will develop is the first and most important question in electro-chemistry. Of course, the best and surest way to arrive at this E. M. F. is to determine it by actual experiment with a voltmeter, or, still better, by comparison with a standard cell. There are, however, many times when the materials or instruments are not at hand, and a calculation or predetermination of the E. M. F. is very convenient.

The formula for calculating the E. M. F. is obtained by assuming that the electrical energy of the given chemical combination is equal to the heat energy which the same combination is capable of producing, or $EC = 4.16\,Ca\,H$. That is, volts multiplied by coulombs is equal to the coulombs multiplied by the electro-chemical equivalent, *i. e.*, the weight of material required per coulomb and that by the heat produced by one gramme of the material. Cancelling the C in both members, we have $E = 4.16\,aH$, in which E is the E. M. F. in volts, a is the electro-chemical equivalent (grammes per coulomb), and H is the number of heat units (gramme-degrees Cent.) produced per gramme of material by the given chemical combination. The values of a and H are given for most materials in electrical and chemical books of reference, and the calculation is a very simple one. Nevertheless this formula and the principle involved in it are not generally understood and are very seldom used. The equation deduced above is that ordinarily given, but what I have found to be a more convenient form of it is obtained by assuming that $E = H$, giving a its value for hydrogen (.00001035). Solving with respect to H we have $H = 23300$, which means that 23300 is the number of heat units per equivalent corresponding to one volt, and all that is necessary to find the E. M. F. of any given chemical combination is to divide the number of heat units per equivalent (which is the form they are almost always given in) by 23300 and the quotient is the E. M. F. in volts. For example, to obtain the E. M. F. which zinc and free chlorine will develop divide 48,600 (which is the number of heat units produced by the combination of one equivalent of zinc with one of chlorine as given by Thomsen) by 23,300, and the result 2.09 is certainly very close to 2.11, the actual value obtained by experiment. In the same way the E. M. F. of other combinations of materials may be predetermined, but it should always be borne in mind that the heat of combination corresponding to one *equivalent* of the material should be taken and not necessarily that corresponding to one atom; as for example in the case of zinc, the heat per atom (65 grammes) is 97,200 which has to be divided by 2 to reduce it to one equivalent because zinc is a dyad and takes two atoms of chlorine, which is a monad. In the case of monad metals like sodium, potassium, and silver the figures may be taken just as they are given in the tables. Mistakes very frequently arise in this way; in fact I do not think I ever saw a table of electrochemical equivalents in which this point was correctly introduced in every case.

In order to test the practicability and accuracy of calculating E. M. F., as well as to obtain reliable results and full data for their own value, I determined the E. M. F. given by thirteen of the most important metals in combination with free chlorine, bromine and iodine, and the results are given in tables A, B and C respectively. In table D, I have averaged these results and placed them side by side with the results obtained by calculation. The agreement between the two sets of figures is not perfect by any means, but when it is remembered how the E. M. F. of a cell will change one or two-tenths of a volt on apparently the slightest provocation, I think the figures are strikingly close, more so than I expected to find them. In more than half of the cases the difference is less than one-tenth of a volt, and the average difference is only slightly more than that. There has been no warping or coaxing of the figures to secure uniformity. The results are

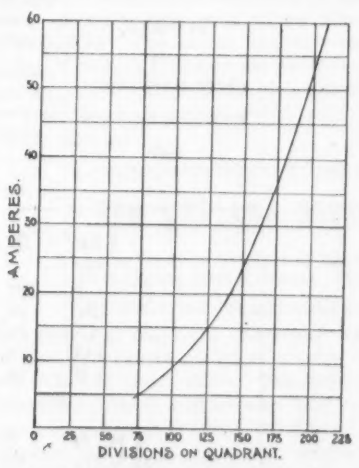


FIG. 3.—THE "MOLER" SWINGING ARM GALVANOMETER.

given just as they came. If figures were picked out from the different observations it would be possible to obtain almost perfect agreement between the calculated and determined, as one may see by looking over the tables.

In regard to the experimental results as given in tables A, B and C, I may state that all the metals and salts used were chemically pure, with the exception of the metals magnesium and aluminium, and these were of a very good quality. Pure carbon plates were used for the negative plate, but platinum was also tried and gave substantially the same results. The E. M. F. was measured by a Thomson reflecting galvanometer (by Elliott) using two independent standard Daniell cells. One fact which strikes one in looking over the tables A, B and C, is that the E. M. F. is not very greatly affected by the solution; a certain metal gives about the same result in one chloride as in another, and the same is true of the bromides and iodides. In table E, I have given the E. M. F. obtained by substituting different metals for the zinc in a Daniell's cell, but these results being from only one series of observations are probably not so reliable as those in the preceding tables.

In the remaining table I have collected in condensed form the principal facts in regard to batteries in which zinc is used as the electro-positive material with the most important electro-negative or depolarizing materials. The

facts in regard to metallic zinc, which hold good in all cases in which it is used (no matter what the other material is), are given on a horizontal line with zinc. Below this the facts in regard to each particular combination are given opposite the depolarizer. For example, the data of a zinc and chlorine battery are given on a horizontal line with chlorine, of a zinc and nitric acid (Bunsen) battery on a line with nitric acid.

For convenience the table is divided into two parts; the left-hand side contains the purely scientific data, and the right-hand portion contains the practical facts.

In the first column of the first part are given the chemical symbols reduced to a common basis, any one of the expressions being chemically equivalent to any other. For example, one-half atom of zinc ($\frac{1}{2}$ Zn) requires one atom of chlorine (Cl), or one-half atom of oxygen ($\frac{1}{2}$O), or one-third molecule of chromic acid ($\frac{1}{3}Cr_2O_3$), or one-sixth of the mixture of one molecule of potassium bichromate and seven molecules of sulphuric acid ($\frac{1}{6}$ [$K_2Cr_2O_7 + 7H_2SO_4$]), and so on.

In the second column is given the chemical equivalents which are simply the proportions by weight required of the different materials. That is, when we use 32.5 grammes (hydrogen being assumed as one gramme), we require 35 5 grammes of chlorine, or 53.4 grammes of chromic acid, and so on.

The third column contains the electro-chemical equivalents, which are really exactly the same and directly proportional to the combining weights in the previous column, but are reduced to an electric basis of so many milligrammes per coulomb. To convert these figures into grammes per ampère hour simply multiply by 3 6.

In the first column of the second part of the table is given the E. M. F. of each combination, all of which with the exception of oxygen, sulphur and water are determined by experiment, most of them being well known and accepted values. In the case of oxygen, sulphur and water the E. M. F. is calculated as explained above and are merely given for comparison. No actual battery corresponding to these materials exists.

In the second column, on the right-hand side, is given the number of pounds of zinc required per horse-power hour in the case of each combination. For example, a zinc and copper sulphate (Daniell) battery requires 1.86 pounds of zinc per horse-power hour of electrical energy produced.

In the next column I give the weight of depolarizer required per horse-power hour in the case of each combination. For example, a battery requires 5.05 pounds of the mixture of three parts of potassium bichromate, and seven parts of sulphuric acid, which is about the ordinary strong bichromate solution for porous cell batteries. Of course the water required for the solution is not considered here or in any of the other figures of the tables, because it costs nothing and serves merely as a medium of electrical action; but if the total weight of solution is desired, the weight of water must be added.

The weight of the different materials consumed per ampère hour is given in the next column. These figures are obtained directly from the electro-chemical equivalents in the third column by dividing by 125; in fact, they are simply the electro-chemical equivalents in pounds per ampère hour.

It should always be carefully noted that the weight consumed per ampère hour is that required in *each cell* in *series*, whereas in the case of horse-power hours the weight given in the table is the total weight used, no matter how many cells there are or how they are arranged.

In the next to the last column is given the wholesale cost per pound of the different materials. These prices are of course very difficult to fix, because they depend upon the market and vary greatly upon the quantities bought; but the prices I have here are very low and ordinary consumers would have to pay twice as much in most cases; they give, however, some idea of costs.

In the last column I have given the cost of both materials, zinc and depolarizer, added together. I have not here considered the values of the products, because it is very difficult to estimate the cost of collecting and utilizing residues. In the case of silver chloride the silver resulting from the action would, of course, be worth a large portion of the cost of the original chloride.

One of the interesting points which this table shows is the total weight required per horse-power hour. For ex-

TABLE A.

E. M. F. produced by different Metals in Combinations with Free Chlorine in Solutions of —.

	Magnesium Chloride.	Zinc Chloride.	Zinc Chloride.	Zinc Chloride.	Hydro-Chloric Acid.	Common Salt.	Average.
Magnesium	2.83 2.65	2.65			3.2–3.15	2.85	3.1
Zinc	2	2 20	2.13	2.11	2.20	2.18	2.11
Cadmium		1.94		1.86	1.98	1.93	1.9
Aluminium	1.75	2.04	1.88		2.02	1.98	2.
Iron		1.60	1.56	1.5	1.67	1.68	1.6
Cobalt		1 43	1.43	1.41	1.50	1.45	1.43
Nickel		1.33		1.27	1.40	1.33	1.33
Tin	1.50	1.70	1.6	1.57	1.68	1.66	1.61
Lead		1.63	1.62	1.60	1 68	1.65	1.63
Copper		1.31	1.30	1.29	1.37	1.34	1.32
Silver		1.11	1.12	1.13	1.15	1.10	1.11
Antimony		1.20	1.23	1.25	1.25	1.08	1.22
Bismuth		1.29	1.25	1.20	1.27	1.19	1.21

TABLE B.

E. M. F. of different Metals with Free Bromine in solutions of

	Magnes. Bromide.	Nickel Bromide.	Potass. Bromide.	Hydro-Bromic Acid.	Magnes. Br'mide weak.	Average
Magnesium	2.55	2.45	2.51	2.7	2.57	2.56
Zinc	1.84	1.78	1.82	1.79	1.85	1.79
Cadmium	1.6	1.54	1.62	1.57	1.61	1.58
Aluminium	1.5	1.46	1.47	1.46	1.6	1.53
Iron	1.22	1.25	1.31	1.26	1.33	1.3
Cobalt	1.1	1.02	1.05	1.06	1.13	1.05
Nickel	.8	.85–.8	.8	.87	.94	.85
Tin	1.12	1.31	1.3	1.25	1.27	1.3
Lead	1.4	1.27	1.33	1.28		1.33
Copper	1.05	.96	1.01	.99	1.03	1.02
Silver	.97	.94	.97	.95	.93	.95
Antimony	.99	.73	.71	.87	.97	.8
Bismuth	.92	.9	.96	.88	.92	.92

TABLE C.

E. M. F. of different Metals with free Iodine in solutions of —,

	Magnes. Iodide.	Zinc Iodide.	Potass. Iodide.	Average
Magnesium	2.02		2.00	2.01
Zinc	1.35	1.23	1.29	1.25
Cadmium	1.12	1.12	1.13	1.12
Aluminium	.92	.83	.87	.88
Iron	.69	.6	.74	.68
Cobalt	.6	.42	.5	.51
Nickel		.35	.37	.36
Tin		.72	.69	.71
Lead		.82	.85	.83
Copper	.63	.67	.62	.64
Silver	.65	.67	.64	.65
Antimony	.41	.47	.46	.44
Bismuth	.39	.46	.42	.43

TABLE D.

Comparison of the E. M. F. Calculated from the Heat of Combination and the E. M. F. determined by experiment.

Metals.	Combining with Chl'rine Calc.	Determ.	Bromine Calc.	Determ.	Iodine Calc.	Determ.
Magnesium	3.24	3.1				
Zinc	2.09	2.11	1.68	1.79	1.05	1.25
Cadmium	2.	1.9	1.58	1.58	.97	1.12
Aluminium	2.3	2.	1.7	1.53	1.00	.88
Iron	1.75	1.6	1.5	1.3	.85	.68
Cobalt	1.64	1.43				
Nickel	1.57	1.33				
Tin	1.71	1.61	1.5	1.3		
Lead	1.76	1.63	1.38	1.33	.85	.83
Copper	1.4	1.32	1.07	1.02	.69	.64
Silver	1.25	1.11	.97	.95	.59	.65
Antimony	1.3	1.22				
Bismuth	1.3	1.21				

TABLE E.

E. M. F. produced by different Metals substituted for the Zinc in a Daniels cell.

Metals.	Volts.	Metals.	Volts.
Zinc	1.08	Lead	.58
Cadmium	.79	Copper	.07
Aluminium	.65	Silver	—.03
Iron	.64	Antimony	.09
Cobalt	.40	Bismuth	.17
Nickel	.1		

SYMBOLS. Chemical expressions reduced to a common basis.	CHEMICAL EQUIVALENTS. Proportions in which materials combine. H=1.	ELECTRO-CHEMICAL EQUIVALENT. Weight of material consumed per amp. sec. milligrams per coulomb.	NAME OF MATERIALS.	Electro-motive Force produced. Volts.	Weight of zinc consumed per Horse Power hour. Pounds.	Weight of Depolarizer consumed per Horse Power hour. Pounds.	Weight of Materials consumed per amp hour in each cell. Pounds.	Cost of Materials wholesale. Per Pound.	Total Cost of both positive and negative materials per Horse Power hour.
½ Zn	32.5	.337	Metallic Zinc,				.0027	$.07	
+			used with following electronegative or depolarizing elements:						
I	127.	1.314	Free Iodine	1.2	1.67	6.53	.0105	3.50	$22.97
Br	80.	.828	Free Bromine	1.79	1.12	2.76	.0066	.38	1.12
Cl	35.5	.367	Free Chlorine	2.11	.95	1.04	.0029		
½ O	8.	.083	Free Oxygen*	1.9	1.05	.26	.00066		
½ S	16.	.166	Free Sulphur*	.95	2.1	1.03	.0013	.02	.17
			CHEMICAL COMPOUNDS.						
½ H_2O	9.	.093	Water *	.5	4.	1.1	.00074		
HNO_3	63.	.652	Nitric Acid	1.9	1.05	2.04	.0052	.06	.20
⅓ CrO_3	33.4	.346	Chromic Acid	2.	1.	1.03	.0027	.20	.28
½ $CuSO_4$	79.7	.826	Copper Sulphate (anhyd.)	1.079	1.86	4.55	.0065		
½ $CuSO_4 \cdot 5H_2O$	124.7	1.29	Copper Sulphate Crystals)	1.079	1.86	7.13	.0102	.06	.56
½ Fe_2Cl_6	162.5	1.683	Iron Perchloride	1.55	1.3	6.5	.0133	.10	.74
Ag Cl	143.5	1.487	Silver Chloride	1.06	1.89	8.32	.0118	16.00	133.25
½ Hg_2SO_4	248.	2.57	Mercury Sulphate	1.42	1.41	10.7	.0204	.50	5.45
			MIXTURES.					Mixture per lb.	
⅙ { $K_2Cr_2O_7$ } { $7H_2SO_4$ }	163.5	1.694	{ Potass. bichrom, 3 pts. } { Sulphuric acid, 7 parts }	2.	1.	5.03	.0133	.04	.27
⅓ { $K_2Cr_2O_7$ } { $4H_2SO_4$ }	229.*	2.37	{ Potass. bichrom., 3 pts } { Sulphuric acid, 4 parts }	2.	1.	7.04	.0186	.05	.42

* Calculated.

ample, .95 pound of zinc and 1.04 pounds of chlorine, making a total of almost exactly 2 pounds, would produce one horse-power of current for one hour if all of the chemical energy could be converted into electric energy.

This brings up the question of how large a percentage of the chemical energy can be utilized, or, in other words, the efficiency of chemical generators. This efficiency is higher, I think, than it is generally supposed to be. I have no exact figures upon this point, but I have tested several times the weight of zinc consumed compared with the theoretical amount, and I have found that even in a plunge battery, where the bichromate solution was directly in contact with the zinc and the opportunity for local action was a maximum, that the zinc efficiency was as high as 75 per cent. and in one case 80 per cent. In a porous cell battery with amalgamated zinc, where there was little or no cause for local action, I believe the zinc efficiency would be as high as 90 per cent. and I should not be surprised to find it as high as 96 or 97 per cent.

The efficiency of the depolarizer is generally lower than that of the zinc, because there is generally a good deal of chemical energy left in the solution after it is too weak for satisfactory work. The efficiency of the bichromate solution in the plunge battery I have just referred to was only about 45 per cent. of the total theoretical power. But this is very low, because the solution has to be weak in acid on account of being used in contact with the zinc. In the case of a copper sulphate battery, where the crystals of sulphate are often almost entirely used up, I think the efficiency would be as high as 80 or 90 per cent.

The efficiency I speak of here is simply the *chemical* efficiency in the battery; the fall of potential in the battery due to its internal resistance compared to the external is another loss which has to be added to the chemical loss in determining the total efficiency. The possibilities of chemical generators are therefore almost infinite, since it requires theoretically a total of only 2 pounds of zinc and chlorine, and two pounds of zinc and chromic acid per horse-power hour, and since the efficiency of batteries can easily be made as high as 75 per cent. it follows that less than three pounds of material is actually required per horse-power hour; but unfortunately the water for the solution, the containing vessel, electrodes, etc., are so heavy that the total weight is very many times greater. The possible and the actual battery are thus very far apart. If we use metals of higher chemical affinity and E. M. F. than zinc the theoretical weight of material required is even less; only one pound total of chlorine and magnesium are required per horse-power hour, with metallic sodium and free chlorine having a calculated E. M. F. of 4 volts it would only take about .8 pound per horse-power.

The easiest and best solution of the problem, however, does not seem to be the use of more powerful metals than zinc. The latter is powerful enough; it only takes, as we have seen, about one pound of it per h. p. hour with nitric acid, chromic acid or bichromate solution, and less than two pounds with copper sulphate. The opportunity for improvement seems to lie more in the direction of perfecting the general form of batteries. The *apparatus* is at fault, not the *chemical action*. Moreover, zinc is about as high on the electro-positive scale as it is safe to go so long as water is present. Even in the case of zinc, its affinity for oxygen is greater than that of hydrogen; it is therefore only by tolerance, so to speak, that zinc remains passive in the presence of water. If it is not properly amalgamated, or if the solution is too strong, local action does occur. If, in place of zinc, we use any more electro-positive metal these troubles are aggravated; with magnesium, for example, there are only very few solutions in which it will stand without great local action. Metals of still higher power, such as sodium, cannot be used at all in presence of water. Jablochkoff has, I believe, made cells in which sodium is used with damp cloth, but this can hardly be considered as water.

The proper way to use metals of great chemical energy would seem to be with liquids which do not contain any oxygen, but unfortunately such solutions are not generally good conductors. Another possible plan is to employ a fused electrolyte, but this involves the serious difficulty of maintaining it in the fused state.

So far as I can see zinc is a very satisfactory positive material for batteries. After all it is cheaper than any other metal except iron. It is a sufficiently good conductor and less dirty and liable to corrosion than almost any other metal; it is also, as I have just shown, about as high on the electro-positive list as it safe to go.

The electro-negative materials on the other hand leave far more to be desired. They are generally expensive, very troublesome to handle, and introduce that quality of simple dirtiness, to which no other name can be applied, and which is really the most serious objection to batteries. The electro-negatives will, however, do the work, and as we have seen it actually requires very little weight to give a great deal of power, if the materials could only be used in a more perfect manner than at present. That seems to be the thing to hope for. Another serious difficulty with batteries is their high internal resistance. A dynamo can easily be made to give 100 volts with a thousandth or a few ten thousandths of an ohm internal resistance, hence their great output; but a battery capable of giving 100 volts with only one thousandth of an ohm internal resistance would probably fill this house.

In this connection it will be interesting to consider how many cells of ordinary gravity battery are required to give one horse-power of current. Each cell will give one volt and not more than half an ampère under normal conditions, hence each cell furnishes half a watt or about 1,500 cells to the horse-power! These cells would, however, give that power for a long time. But the fact remains that that very large number is required to produce the power which a dynamo not much larger than one's hat will generate.

In conclusion, I would say that I am by no means a skeptic in regard to chemical generators of electricity; the possibilities are very, very great, as I have shown. But these possibilities do not seem to have been brought to reality in a very perfect manner as yet. But batteries, even in the imperfect state in which they exist to-day, have their useful and legitimate function. A Leclanché cell is exceedingly well adapted to ringing electric bells intermittently and to telephone work, and gravity batteries have long done good service for telegraphic purposes.

But when it comes to developing any considerable amount of actual power, then the limitations become apparent. When we remember that battery electricity will certainly cost in practice 50 cents per horse-power hour, since the materials alone cost 25 cents, and that dynamo electricity only costs 2 cents per horse-power hour, the claims of some primary battery electric lighting promoters show up in their true light. As a luxury, of course, it makes very little difference what it costs, but even then people soon tire of paying very high prices for that kind of a luxury. For small electric lighting and small power in special cases batteries are useful, particularly where no other source of current is available. A physician or dentist to whom a horse-power hour may be worth hundreds of dollars could almost afford to use a chloride of silver battery and throw away the silver.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
168-177 POTTER BUILDING, NEW YORK, May 21, 1888.

T. F. Hunter & Co.

This new firm, of 34 Church street, are now putting in a Loomis incandescent lighting plant for R. Hey & Sons, of Philadelphia, of 200 lights capacity. They are to begin one on May 21 for the Davis & Furber Machine Company, of Andover, Mass. They recently installed and equipped a Sawyer-Man plant of 80 lights, for the Copperfield Mining and Smelting Company. They have several other contracts on hand of this kind. Their supply business is growing steadily, and actually doubling every month. They report an excellent demand for Clark wire.

The Empire China Works.

These works, at Greenpoint, L. I., have added an electric light plant for the illumination of their large factory, and have also improved their facilities for turning out porcelain insulators in every conceivable style, and in the largest quantity.

Personal.

Mr. Peter R. Brodie, an experienced brass-founder, has just opened an office and foundry at 58 North First street, Brooklyn, E. D., where he will be pleased to undertake work for the manufacturers of dynamos, motors and electrical apparatus generally.

The New Sawyer-Man Factory.

I had the pleasure last week, through the courtesy of Mr. H. C. Davis, to inspect the new immense lamp and switch factory of the Sawyer-Man Electric Company, on Twenty-third street, between Tenth and Eleventh avenues. Mr. J. H. Robertson, the superintendent, was kind enough to conduct me through the various departments. The basement is devoted to generating purposes, and contains a 125 h. p. Westinghouse engine, which drives several dynamos, whose current is used in the testing of the lamps. There is also a smaller Westinghouse engine, which drives the new vacuum pump invented by Mr. Packard, with 10 × 12 inch cylinder, as well as two not so large. These pumps are all connected by large leaden air conductors to the testing-room on the fourth floor. There is also an auxiliary plant of 128 accumulator cells, to be used when the prime power is not in service. The first, or main floor, is devoted to the general, offices of the company. Gen. C. H. Barney, the general manager, has a separate office there, and separate provision is also made for his assistants. Part of this floor is also given up to the making of switches, sockets, etc.

The second floor is now occupied by 94 mercury pumps and columns grouped in sections, all the pumps and sections being controlled from one point with a bell and indicator to notify the foreman when to reverse the air from one set of pumps to the other, allowing the mercury to rise and fall correspondingly. This floor, when complete, will contain 240 pumps, all of which will be controlled automatically from one central point. The third floor contains at the present time the staff of men engaged in making the mercury pumps, and they are necessarily very expert and accurate in their work. On the other floors are a large number of female operatives engaged in various details of cutting the filaments, inserting them in the lamps after preparation, etc. The lamps, after being passed through the exhaust department, are sent upstairs and tested, then polished and sent to the storeroom, where they kept in stock in all sizes and in large quantities. The company are now furnishing lamps with the Edison screw sockets, Mather sockets, or their own. In addition to the large main building just spoken of, the company have a solid brick fireproof building in the rear, one end of which they are fitting up with engine, Packard pumps, etc., for a laboratory; the other end is now used as a boiler-room, and for treating carbons. A great deal of credit is due to all who have been engaged in organizing the work, and to Mr. Robertson and his assistant, Mr. Packard, for the care and judgment shown in the carrying out of every plan and detail. I may perhaps note that where men glass blowers were formerly employed, Mr. Robertson has introduced women, who are, he says, more expert than the men, and are able to turn out several times more lamps at much less expense.

The Sprague Company.

The Sprague Electric Railway and Motor Company have now received notification of the acceptance by the Richmond Union Passenger Railway Company of the electrical equipment of the road. The work on this road has been watched with the utmost interest all over the country, being the greatest enterprise of the kind ever attempted. A letter from the street car company, signed by T. N. Motley, H. Steers and M. B. Flynn, says: "We must confess that we sometimes shared the doubts that others have been so free to express as to the possibility of the successful completion of this work, and hence it is with the greater pleasure that we acknowledge the successful fulfillment of all the terms and conditions of the contract, and compliment you on achieving so signal a success." The letter closes by a statement that the company already contemplates an increase of equipment, and hopes before the close of the year to have at least 70 Sprague cars in operation. The road now has about 25 cars in regular operation, and carries on some days as many as 13,000 passengers. The Sprague company are now in their fine new offices on the fifth floor of 16 and 18 Broad street.

The Junior Edison Association.

This association was formed recently, and holds its meetings on alternate Thursdays in the vice-president's room at the Edison United Manufacturing Company's headquarters, 65 Fifth avenue. Lectures are given on various subjects of interest for discussion. Among recent lecturers has been Mr. J. W. Howell. Mr. C. J. Field is president of the association.

The American Company.

The American Electric Manufacturing Company moves to-day to No. 3 East Fourteenth street, over the Fourteenth Street Bank building, in order to be nearer the factory. The American Electric Construction Company has removed to the old building of the New York Club, at the junction of Fifth avenue and Broadway. The new officers of the manufacturing company are: H. C. Adams, president and general manager; F. E. Allen, secretary and treasurer, and J. J. Wood, electrician and superintendent.

The American Electrical Works.

Mr. P. C. Ackerman, representing the American Electrical Works in this city, tells me he finds the demand very active, especially for their patent rubber covered wires, which are coming into greater vogue than ever for arc light circuits, as the result of the imperative demand for first-class insulated wires. I don't think I have noted before the fact that the concern have had 70 miles of this wire on arc circuits at Albany, N. Y., for some seven years, and the manager of the company reports the wire to be in perfect condition to-day. Such a record is very hard to beat.

Steamship Equipment.

The new steamer "Connecticut" will be fitted up by the Tucker Electric Manufacturing Company with an electrical equipment, under the supervision of Mr. E. W. Seymour, who has charge of the house construction department. There will be a 200 number annunciator as well as a special fire-alarm bell service, with 26 stations in all parts of the boat. These stations will only be known to employés. The Tucker Company are also fitting up in the pilot house an electrical indicator which will tell every motion or change of motion of the shaft. The needle in this instrument follows the shaft absolutely. Another instrument in the pilot-house registers also, automatically, every revolution of the shaft. By these two instruments, therefore, the pilot or captain can see at once the direction and speed of the vessel, and can guard against many dangers during a fog. The wiring of the boat for electric service will be complete in every detail. The best white rubber core Habirshaw wire will be used, and all exposed runs will be made with lead covered wire. The buttons and plates in the staterooms will be of ivory.

Mayor Hewitt and the Wires.

Mayor Hewitt has addressed a letter to Corporation Counsel Beekman in which he says: "Some time since I was requested by the Board of Electric Control to give an order to the Commissioner of Public Works to cause to be removed by the Bureau of Incumbrances certain poles and electric wires which were specified in the resolution. On reference to the statute I find that no duty is imposed upon the Mayor, but there is a duty imposed upon the Commissioner of Public Works, provided the Mayor shall see fit to give him the written order to remove these poles and wires. * * * Inasmuch as the Commissioner of Public Works cannot execute an order to remove these wires and poles, and as any attempt to do so would probably result, first, in leaving the streets through which the wires pass in total darkness, and, secondly, in the loss of life caused by the high tension current which would thus be discharged into the streets, I suggest that proceedings shall be taken in the courts to compel the electric light companies to comply with the notice which has been served upon them by the Subway Commission. * * * I have done all in my power to urge on the construction of the subways in order that the transfer might be made to a very considerable extent before the close of the present year."

The New York Insulated Wire Company

notifies its friends and customers that it has removed its Boston offices from from 11 Central street to 160 Congress street.

The Magnolia Anti-Friction Metal.

Reports of a very interesting series of tests are published by the Magnolia Anti-Friction Metal Company, of 102 Chambers street. The tests on the metal were made by the Bureau of Steam Engineering of the Navy Department, and show the metal to compare remarkably, for use in bearings, etc., with any other now in use. A copy of the report can be obtained by addressing the company. It seems to me that such a metal would find a large application in electric light stations.

W. T. H.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
48 Congress Street, Boston, May 21, 1888.

An Active and Prosperous Company.

It is reported that the Eddy Electrical Manufacturing Company, of Hartford, Conn., has leased a large and well equipped factory at Windsor Locks, Conn. This, together with the company's Hartford factory, will increase the manufacturing facilities to such an extent as to enable the Eddy people to promptly fill the rapidly increasing orders for their electric motors and electro-plating machines, and give them the necessary room for perfecting and placing in the market several new and novel electrical specialties.

Personals.

Mr. A. J. De Camp was in Boston last week. On last Wednesday evening Mr. De Camp attended the opening of the series of scientific readings at the rooms of the Boston Electric Club, and participated in the interesting and instructive discussions.

Mr. Axel Ekstrom, who has been for several years past connected with the Lynn, Mass., factory of the Thomson-Houston Electric Company, recently resigned his position to accept another one—more important and lucrative—abroad; yet practically remaining in the service of the company named. Mr. Ekstrom will represent the Thomson-Houston International Company in Sweden, and will make his headquarters at Stockholm, which, by the way, is this gentleman's birthplace.

More "Faraday" Going Down.

Post Office Square, Boston, Mass., was the scene of unusual activity for several days last week. Several "gangs" of laborers were busy drawing in new lead encased Faraday cables (several thousand feet) in the conduits of the New England Telephone and Telegraph Company. Mr. Wm. H. Sawyer, of the American Electrical Works, Providence, R. I. (where the Faraday Cable is manufactured), was supervising the most important

part of the work, that is, the placing of two cables in one duct, each cable made up of fifty pairs of wires, and the two combined containing 100 metallic circuits, having an unusually low static capacity.

Thomson-Houston Business Booming.

At the executive offices of the Thomson-Houston Electric Company, in Boston, the following new installations of arc lights are reported: Scranton, Pa., 50; Dakota Building Association, 35, isolated plant; Sioux City, Iowa, 35; Lawrence, Kan., 70: Madison, Wis., 30; North Danville, Va., 30; St. George, Staten Island, 100; Reidsville, N. C., 50. And the following increases: Toledo, O., 50; Houghton, Mich., 30; Cambridge, Mass., 45; Ware, Mass., 20; Orange, Mass., 20; Ashland, Mass., 50; Augusta, Ga., 50; Northern Electric Light Company; Philadelphia, Pa., 50.

The first of the Thomson-Houston electric motors installed by the New Bedford Gas Company was started last week with great success; the motor did the work required perfectly, and all who saw it were very much pleased with its operation. The Salem *News*, of Salem, Mass., has purchased a 10 h. p. Thomson-Houston motor through the Eastern agent, Mr. H. C. Spaulding, to be used in operating its printing press, making eight motors which the company have recently installed for this purpose, besides those for several printing establishments. After a most thorough and exhaustive examination of the various electric railways, the East Side Street Railway Company, of Brockton, Mass., have decided to adopt the Thomson-Houston system. Mr. E. P. Shaw, of Newburyport, Mass., will use the Thomson-Houston system on his Salisbury Beach Railway. The company reports great activity in railway matters. A large number of contracts have been signed and work on new roads is being rapidly pushed.

The Panama Electric Light Company, Gen. R. Santo Domingo Vila, Superintendent, which has lighted Colon satisfactorily for the past year or so, and has a similar concession for Panama from the government for a certain number of years, has turned its attention to this city, and is now actively engaged in the preliminary arrangements for the introduction of the electric light there. Mr. Chas. W. Grant, an experienced electrician and mechanical engineer, of the Thomson-Houston Electric Company, of Boston, Mass., arrived on the Isthmus by the "Colon" on the 19th inst. to superintend the putting up of the plant and to place it in complete running order. As soon as the site is definitely secured, the work will be immediately begun. It is expected that three or four weeks will suffice to get the building up, and a couple of months to get the plant in running order, wherefore the inauguration of the electric light in Panama for public purposes may not take place before the month of July. The bulk of the machinery, consisting of thirty-five cases, is already on the ground, and the rest has gone forward on the "Newport," from New York. One Thomson-Houston arc dynamo, for the outside lights, and one Thomson-Houston incandescent dynamo to carry one thousand lamps on the alternating system, for the inside lights, will be used in Panama. The company will start with forty-five arc lights in the streets of the city. Almost four hundred incandescent lights, for inside purposes, have been already engaged.

At West St. Paul, Minn., the new Thomson-Houston electric railway works admirably. A reliable report says: "The motor car that left the foot of Jackson street at 12:05 P. M. to-day, had on board two car loads of representative St. Paul and Minneapolis business men, among them a majority of the Boards of Aldermen and city officials of both cities. In fact the Minneapolis delegation appeared to be more interested in the success of the scheme than the St. Paul crowd. As had been previously advertised in the city papers, the special object of the excursion was to witness the operation o the new electric motor at South Park, over which Mr. J. H. Lawrence and the South St. Paul Rapid Transit Company have labored for the past year. Arriving at South Park the delegations from both cities, headed by Mr. Lawrence, proceeded to the corner of Allison avenue and South Concord street, where is located the east end of the motor line. The operator, two press representatives and Mr. J. H. Lawrence made the first trip up the curve and back just to see how the machinery would work, while the crowd scattered about on the surrounding elevations and watched with admiration the success of the scheme, which all were carried away with. The working of the machinery has been already described. It is enough. From the first trip until all the crowd had ridden to their heart's content, the motor car was kept plying up and down the steep grade and around the angles (not curves), which are to be found all along the line. Though the track was wet and the rails rusty, the machinery moved without a hitch, everything passing off to equal the highest expectations of the parties interested in the scheme. When the operation of the motor had been satisfactorily tested the party adjourned to the dining room of the Grand Hotel, where they were the guests of Mr. Lawrence to lunch. After the guests had partaken of the excellent lunch provided, their host made a brief speech and was followed by Mayor Ames, of Minneapolis, and others." W. I. B.

BIRMINGHAM, Conn.

A brief history of the Ansonia, Derby & Birmingham Electric Railroad, with a description of its present workings, will be interesting. The project was the conception of Mr. W. J. Clark, and at a session of the Connecticut Legislature in 1887 the charter of the company, then held by him, was amended, giving the company extraordinary powers, among which was the right to carry freight as well as passengers. Associated with him in the enterprise are Mr. H. Holton Wood, of New York; Mr. J. B. Wallace, George O. Sneller and others, of Ansonia, Conn. After a thorough examination of the various electrical systems, about a year since they closed a contract with the Van Depoele Electric Manufacturing Company for their equipment, and proceeded to construct the line with a view particularly to freight traffic, being authorized to connect various large mills at Ansonia with navigation at the wharf at Derby. The rolling stock equipment is therefore somewhat different from that of the ordinary street railway, consisting principally of specially built freight cars, to draw which they have a 75 h. p. motor placed upon a special motor car. The passenger equipment at present consists of three cars with motors and one ordinary passenger car; but owing to the demands of the passenger traffic they will at once double this equipment. The completion of the line was delayed several months on account of extensive grading, which was in progress by the municipal authorities, so that it is only within the last few days that they have been able to put it in operation. Everything so far has worked in the most satisfactory manner, and I think, without exception, it is the smoothest running electric railway in the country, this fact being probably partially accounted for by the substantial road-bed, and partially by some of the later improvements in the Van Depoele system. The freight motor is really a marvel, it pulling with ease all the freight cars which they can put behind it and get upon the sidings. They use a single overhead conductor arranged for the under contact traveler. The equipment at the power station consists of a 175 h. p. Manning boiler, a 125 h. p. Hewes & Phillips Corliss engine and a 100 h. p. Van Depoele generator and exciter.

PHILADELPHIA NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
39 South Tenth Street, Philadelphia, Pa., May 19, 1888.

Baltimore Gas Company.

A dispatch from Baltimore says that, in pursuance of a State law, a consolidation of all gas companies has been effected, and the price, also fixed by law, will be $1.25 per thousand feet. There are already several electric light plants in operation, and a great many buildings and stores are using electricity, which is found to be much cheaper than gas at the price named.

South Jersey Telegraph Company.

The South Jersey Telegraph Company held its annual meeting in Camden Tuesday last and elected the following officers and directors: President, James Merrihew; Secretary, Charles A. Jenke; Treasurer, W. J. McLaughlin; Superintendent, W. T. Westbrook; Directors, Charles A. Tinker, W. B. Gill, James Merrihew, H. Bentley, S. M. Plush, W. T. Westbrook and George Merrihew.

The Berliner Gramophone.

A very interesting paper on the "gramophone" was read last Wednesday night at the meeting of the Franklin Institute by Emile Berliner. The gramophone is an instrument for catching the human voice and reproducing speech by mechanical means. A demonstration of the work of the instrument was given to the audience by the inventor. The gramophone, it is claimed, will open up a wide field of usefulness, and make a new era in science. It is the intention to have in each city at least one office having a gramophone recorder. All desirous of having their voices "taken" will only have to step before the funnel and sing or speak. The plate may then be developed while they wait, after which the electrotyper can produce as many copies as may be required. The same can be done with performances on pianos and other musical instruments. The inventor claims that prominent speakers, singers or performers may in the near future, by means of the gramophone, derive an income from royalties from the sale of their phonautograms, as the reproductions are called. People with a good collection of phonautograms will be enabled to give interesting entertainments, comprising vocal and instrumental music and recitations. These reproductions can be given years after the originals were made.

Protection from Water Overflow.

Leopold Weil, of New York, also described and illustrated the system of the Electric Water Protective Company for preventing damage to buildings by the overflow of water.

Electrical Conduits.

The Electrical Committee of Councils have decided to report back with a negative recommendation an ordinance authorizing the Board of Highway Supervisors to designate the side of the street in which electric conduits may be laid. An ordinance authorizing the American Light Company of New Jersey to lay underground conduits and wires in the district bounded by Cambria, Girard avenue, Sixth street and the Delaware River was referred to a sub committee.

The Electric Railway.

The new electric motor for propelling street cars will soon be tried on the Lombard and South streets branch of the People's Passenger Railway Company. Workmen are now busily engaged in relaying the tracks with the new rail used for cars provided with the Wharton motor. Eight-wheel cars instead of four will be used. They will be large enough to comfortably seat thirty-four persons. The weight of each car will be 14,600 pounds. An experimental car will first be run on Fourth and Eighth streets, and if it is found practical the cars will be operated on the Lombard and South streets brach.

A Verdict for a Lineman.

Some time ago Martin Doherty, while in the employ of the Brush Electric Light Company, was ordered to go to Thirteenth and Market streets and fix a wire. He accordingly went there, climbed a pole, and in endeavoring to perform the work was severely burned in the hand and in the thigh, necessitating his removal to the hospital. He then brought suit for damages in Common Pleas Court, contending that the wire was what he called a grounded wire, and was therefore dangerous, and that his injuries resulted from the fact that he had not been informed of the wire being grounded, as he should have been. The defense set up that the person from whom Doherty had received his orders to fix the wire was not the superintendent of the company, had no authority to give the order, and in fact had nothing to do with it. The case was tried before Judge Reed, and the jury rendered a verdict of $4,000 for the plaintiff. E. W. E.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
44 Lakeside Building, Chicago, May 19, 1888.

The Thomson-Houston Company.

I have, it will be remembered, before referred to the fact that the Western branch of the Thomson-Houston Electric Company was fitting up an exhibition plant at 148-150 Michigan avenue, which, when complete, would be in all respects a model. With the enormous increase in the business in connection with the Western Department of this company, the demand for a testing department, repair shops and exhibition rooms has increased, and the many advantages of having these facilities are apparent. The loss of time incident to ordering from the Eastern factory the material and machinery necessary to the installation of an electric light plant, as well as the delays incurred in waiting for repairs or stock to arrive from the East, has been fully provided against by the fitting up of their new three-story building. The plant has just been completed and the company removed to its new quarters this week. The location is but a few doors from its former location, and may be regarded as a fortunate one in many respects, being, as it is, opposite the Exposition Building, and situated on the finest avenue in Chicago. The plant comprises two floors and basement, or about 16,800 square feet. The offices are situated on the first floor, occupying the front portion, in the rear of which are the stock rooms, where every kind of apparatus manufactured by the company, including lamps, dynamos, motors, etc., is kept on exhibition. The offices are finished in oiled natural woods, the walls and ceilings harmonizing in color with the woodwork, while the richly colored glass partitions which separate General Manager Barton's suite of offices from the cashier and sales department, make everything complete. The offices are lighted by incandescent lamps. In the stock room all goods are shipped and received, the dynamos and heavy machinery being easily lifted from the trucks outside by means of an overhead rail. There are over 1,400 bins in this department for depositing the various parts of electric lighting apparatus. The basement, which has the same number of square feet as the first floor, contains the engine room, the repairing and testing departments. In the engine room are two 80 h. p. engines, one of the Ball and the other of the Phœnix make, which supply the power for testing and lighting purposes, and are put in in a line on the same side of the basement, one being near enough to the repair shop to enable tests of dynamos to be made without any intermediate shafting. The engines are running very satisfactorily and the engineer is proud of being able to balance a silver quarter on the steam chest with the engine running at 275 revolutions per minute. Steam is generated from two Otis steel tubular boilers, one having the Jarvis furnace setting, and the other the McGinniss. The different furnaces have been put in for the purpose of testing the relative merits of the two. These tests, doubtless, will be of considerable importance to the electric lighting industry of the company, and the results will be watched with a great deal of interest, as the problem of the economical production of steam is one of the greatest in connection with the industry. The repair shop has been fitted up with a great deal of care, and is intended to meet every want in connection with the Western department. The technical department, for making plans, specifications, etc., is located on the second floor. Mention should also be made of the electric railway department of this company. The fact of their recent purchase of the Van Depoele patents with others of similar character, and the combining of them with others of their own, clearly shows the faith the company have in the future of the electric railway. The western department of this branch of the business is now being thoroughly organized and aggressive work has been commenced. On the whole no pains or expense have been spared to make the plant a model one, and the company may feel highly gratified at its success in accomplishing what it set out to do.

A New Electric Light Company.

May 12, license of incorporation was issued by the Secretary of State to the Edgewater Electric light Company, at Chicago; capital stock $100,000; incorporators, John Lewis Cochran, S. Wilmer Connel, and John C. Scovel.

Doings in the City Council.

At a recent meeting of the City Council, the committee on fire and water recommended the passage of the Inter State Telephone ordinance, which has been tabled for several months. The proposition made by this company is to furnish a good telephone service for $50 per annum. In its application for an ordinance, it is not stated what patent it will use. The Committee on Gas and Electric Light recommended the passage of an ordinance giving a franchise to the Chicago Fuel and Light Company. In the ordinance submitted, it is especially stipulated that no combination shall be made with any other company in the production of gas. This with one or two other gas questions was made a special order for the next Monday night.

The Van Depoele Electric Manufacturing Company

Have sold a 20 arc light plant with Van Depoele double carbon lamps to Geo. L. Burtis' mill at Marquette, Mich. Within fifteen days from the time the Van Depoele Company received an order for a 100-arc light plant to take the place of the one at Denison, Tex., which had been through a fire, the new plant was manufactured, set up and running. The machines were manufactured new from the foundations up after receiving the order. The Helena Electric Light and Power Company, of Helena, Ark., have ordered a new 40-light dynamo of the Van Depoele Electric Manufacturing Company, which makes 100 arc lights of this system they will have altogether. The Long Island Electric Company, of Brooklyn, N. Y., have ordered three 60-light machines of the Van Depoele system to light the towns of Jamaica and Woodhaven. The plant will be located in the station of the Brooklyn & Jamaica Electric Railway. The Van Depoele Company are equipping the excursion steamer "John A. Dix" with an arc and incandescent plant, also two Mississippi River excursion boats located at St. Louis.

Personal.

Mr. Norman McCarty, General Managing Agent of the Baxter Electric Manufacturing & Motor Company, called at the office of the WORLD this week. Mr. McCarty is making a general Western trip in the interests of his company. He reports the motor business good.

The Chicago Telephone Company.

The Chicago Telephone Company have just moved into their new building, corner of Franklin and Washington. The wires were transferred Saturday night of last week without breaking the connection more than ten minutes.

The Electrical Supply Company

Are out with a new and handsome catalogue, another one of the series. This one is confined exclusively to electric light tools, and contains illustrations of every kind of tool used in connection with electric lighting. The catalogue is got up with a great deal of taste, the cuts being new. This company have just finished their annual spring house cleaning at their store. Mr. Ernest Hoefer, who has been in the employ of the company for a long time, and is, therefore, thoroughly conversant with the goods sold by them

(and who speaks several different languages) is acting as store salesman.

Central Electric Company.

Mr. W. H. McKinlock, of the Central Electric Company, made a short trip to St. Louis last week, and while there took some good-sized orders for Candee weather proof wire, annunciator wire, and other electrical goods. This company report having received during the past week orders for over 100,000 feet of Okonite wire.

The Electrical Construction Company.

Business with the Electric Construction Company is at present very brisk. Work has been commenced upon some of the large contracts recently received for wiring. At the Hotel Richelieu they are putting in a new annunciator.

Thomson-Houston Plants.

The Thomson-Houston Company have just received an order for apparatus to increase the plant of A. Zeese & Co. The installation of the new arc light plant of C. E. Brown, Forty-first street and Cottage Grove avenue, was completed this week and the lights turned on. Among recent contracts received was on efrom the Fort Scott Electric Light and Power Company, Fort Scott, Kan., for an 800 incandescent light plant.

Stock Quotations.

Col. S. G. Lynch, broker, 146 La Salle street, furnishes quotations upon telephone stock as follows:

Bell of Mo.	$160	@ $165	Iowa Union	$27	@ $28
Central Union	47	@ 48	Michigan	79	@ 80
Chicago	375	@ 400	Missouri and Kansas	69	@ 70
Colorado	19	@ 21	Rocky Mountain Bell	40	@ 45
Cumberland	65	@ 68	Wisconsin	108	@ 109
Great Southern	35	@ 40		E. L. P.	

ENGLISH NOTES.

LONDON, May 9, 1888.

Edison-Swan vs. Anglo-American Brush Corporation.

On the resumption of the incandescent lamp patent trial on Wednesday last, Prof. Frankland gave evidence on behalf of the defendants. His evidence was of a similar character to that of Mr. Crookes, many of the experiments which Mr. Crookes described having been repeated by Prof. Frankland or in his presence with like results. The examination of this witness occupied the whole day on Wednesday, and on Thursday morning Dr. Tidy, who is the official analyist to the Home Office, was placed in the box. His evidence was also of the same general character, and related largely to the results of experiments upon the tar-putty filaments and upon the use of camphor and oxide of zinc, all of which processes are of no practical importance. At the conclusion of Dr. Tidy's evidence the examination of Prof. Silvanus P. Thompson commenced. He deposed to having seen in 1880 the house of Mr. Stearn, at Rockferry, where a number of Swan lamps were in daily use. He first saw an Edison lamp at the Paris Exhibition in 1881; he was of opinion that the Edison lamp, of which a specimen was shown in court, differed from the specification No. 4,576 of 1879 in ten material points, which were as follows: The carbon conductor is made in accordance with Edison's specification No. 578 of 1880; secondly, the conductor has been held in shape during carbonization in the manner claimed in the subsequent specification No. 3,765 of 1880; thirdly, the carbon conductor has its ends kept apart in the manner described in specification No, 1,918 of 1881; fourthly, the clamp which holds the end of the carbon conductor is flattened in the manner described in the specification No. 2,492 of 1881; fifthly, the joint so made has been electroplated as described in specification No. 768 of 1881; sixthly, between the end of the carbon and the platinum wire, which is fused to the glass, there has been joined in a separate piece of wire, not of platinum, as described in specification No. 4,174 of 1881; seventhly, the bulb has not been blown over the rest of the lamp as described in Edison's specification, but has been separately made in accordance with specification No. 2,492 of 1881; eighthly, the platinum wires that pass through the glass are connected to the terminals of another metal in the manner described in the specification last quoted; ninthly, the lamp has been provided at its neck with collar connections in the manner described in specification No. 1,802 of 1881; tenthly, this lamp has been heated during the process of exhaustion in the manner described in specification No. 562 of 1881. Prof. Silvanus Thompson also gave evidence at considerable length upon other points which had already been dealt with by the previous witnesses. The ten points enumerated above contain, however, the gist of his evidence, and probably contributed materially to strengthen the case of the defendants. It was noticeable that in cross-examination the plaintiffs' counsel touched very lightly upon these points, and did not, as might have been expected, take the witness over the ground in detail. The next witness was Prof. John Perry, whose examination and cross examination were gone through without apparently eliciting any thing of material importance on either side. On Tuesday morning Mr. James Swinburne entered the box, and his examination will probably prove to be of great importance. Mr. Swinburne said that he had very great experience in the practical manufacture of lamps. He was first employed at the Swan Works at Gateshead in 1881; he afterwards went to Paris to take charge of the factory there, and after four or five months he proceeded to the United States, where he organized and established a large factory for the manufacture of incandescent lamps. He was manager of the incandescent department of the Hammond Electric Light Company, and is now scientific manager to Messrs. Crompton & Co. He had upon his own account, and entirely apart from this or any other trial, carried out a very large number of experiments upon the manufacture of lamps; he was occupied in this way for nearly two years, his object being if possible to make a lamp which should not contain any devices which he had learnt from Mr. Swan.

The Maxim-Weston Company.

An extraordinary general meeting of the shareholders of this company was held last week "to elect two additional directors and to fix the remuneration of the Board." As will be remembered the affairs of this company have recently been investigated by a special committee, which published a severe report upon many things connected with the management. A meeting was held on April 25 to consider this report, and it was agreed then to have an enlarged committee "to report to the shareholders as to what is best to be done in the interests of the company." The extraordinary general meeting above mentioned was subsequently convened by the chairman of the company, and as many of the shareholders held it to be illegal, a noisy scene ensued. The chairman, after several vain efforts to pour oil upon the troubled waters, was obliged to dissolve the meeting without any business being done. An informal meeting of the shareholders was then held with closed doors, the outcome of which is a public letter from Mr. J. M. Klenck, chairman of the committee, calling upon the shareholders to sign a requisition for a legal extraordinary general meeting. The end of the quarrel will probably be a thorough reorganization of the management, which is certainly desirable if the statements in the report are in any degree true.

THE TELEGRAPH.

Milwaukee, Wis.—The Automatic Fire Service Company, of Milwaukee, has been incorporated by W. Sanderson and others, with a capital stock of $200,000.

Stock Broker Service.—It is said that it is proposed to replace telephones, telegraphs and messengers on the Stock Exchange floor by a pneumatic tube system.

Suppression of Bucket Shops.—A special dispatch from Ottawa, Ont., announces the passing of a law to suppress bucket shops. Penalties will be very heavy and severe, including fine and imprisonment.

The Financial Telegram Company, of Boston, has declared a quarterly dividend of fifty cents per share, payable May 21. The company is out of debt, and has a cash surplus. It reports its business increasing.

The Signal Service.—The chief signal service officer has decided to substitute telegraphic observations at 8 A. M. and 8 P. M. standard eastern time for the three observations now telegraphed. The third telegraphic observations will be replaced by special observations sent direct to General Greely's head office at Washington, to keep the indication officer there fully advised as to specially marked atmospheric phenomena.

THE TELEPHONE.

Arkansas.—It is stated that Mr. J. B. Brockman has made arrangements to build a telephone line, at a cost of $4,250, from Lima Landing to Greenville.

A Pension to Reis.—It is worthy to note that the late Emperor of Germany, just before his death, in recognition of the services of her husband, awarded to the widow of Philipp Reis, a pension of 1,000 marks annually.

Mobile, Ala.—Mr. H. P. Watson, manager of the Telephone Exchange, has been busy lately putting up a number of cables, with the object of reducing the number of single wires now running into the Western Union building.

The Drawbaugh Rehearing.—At a session of the Supreme Court of the United States on the 14th inst., at Washington, D. C., the motion of the People's Telephone Company, representing the Drawbaugh claims for a rehearing in the telephone suits, was denied.

New Telephone Stock.—Circulars have been issued by the American Bell Telephone Company offering to stockholders the right to subscribe at par for $2,000,000 of 10 year bonds at 7 per cent., to meet the construction expenses of the long-distance system. These bonds are redeemable on and after Aug. 1, 1890. Each holder of 50 shares is entitled to subscribe to one $1,000 bond.

Bell Telephone Earnings.—Net receipts for April were $329,000, against $219,000 in April, 1887. Operating profit increased $35,000, and dividends from sub company stocks $75,000, and were no less than $230,000 for the month. The telephone business is paying pretty well at present. The April net income of the Bell Company was 3¼ per cent. upon the capital.—*Boston Herald.*

The Eureka Telephone.—The Eureka Telephone Company was organized about a year ago to manufacture and sell acoustic telephones in the United States and Canada under letters patent now owned by them and issued to W. H. Eastman, D. J. Adams, W. J. Hutchins and others. President A. L. Gladwin says there are over 200 'phones in use. They have sold the States of Pennsylvania and Connecticut, and are negotiating for the sale of five other States, the company reserving the right to manufacture all the transmitters. They propose to reserve Massachusetts and work it themselves. The transmitters and lines are sold outright, the company taking full charge of the lines, if required, for a nominal sum. The company is out of debt, and hopes to have a balance to divide before long.

THE ELECTRIC LIGHT.

Norfolk, Neb., has an electric light company.

Boonville, Mo.—A franchise has been awarded Mr. C. B. Rhodes for electric lighting.

Macon, Ga.—The local Brush Company is negotiating with the city for the purchase of its plant.

Newton, Mass.—The Newton Electric Light Company has a three years' contract for city lighting.

Jackson, Miss.—Bids for the lighting of the city with thirty arcs will be received by the city clerk until July 1.

Binghamton, N. Y.—Tenders for electric lighting for the city have been called for. The contract will be for 100 to 150 arc lights.

Winthrop, Mass.—The selectmen have awarded the contract to the North Shore Electric Light Company, of Revere, for street lighting.

Fall River, Mass.—The Fall River Citizens' Electric Light Company, employing the Ball system, and which was recently organized, has a capital stock of $30,000, and Mr. A. J. Chace is treasurer.

Allegheny City, Pa.—The Allegheny Illuminating Company has been incorporated by J. M. Cleare and others with a capital stock of $25,000.

Delaware, O.—The Delaware Edison Illuminating Company has been incorporated by B. W. Brown and others with a capital stock of $50,000.

The Mather-Tucker Electric Company, of Jersey City, has been incorporated by H. G. Cheney and others, with a capital stock of $350,000.

Garden City, Kan.—The Garden City Electric Light Company will build a large brick and stone station. Mr. S. M. Keller has charge of the work.

Boston, Mass.—The Walworth Light and Power Company of Boston has been incorporated with a capital stock of $15,000.

East Portland, Ore.—The East Portland Lighting Company has been incorporated by C. B. Bellinger and others with a capital stock of $130,000.

Camden, N. J.—The Gloucester City Electric Light Company, Camden, has been incorporated by W. J. Thompson, P. Fowler, G. Muller and others.

Cattlettsburg, Ky.—Mr. H. Wellman, the proprietor of the Cattlettsburg Foundry and Machine Works, contemplates putting in an electric light plant.

Dunkirk, N. Y., is to issue bonds to pay for its electric light plant, which it has secured from the Western Electric Company of Chicago, as previously noted.

Brooklyn, N. Y.—The bill enabling the Brooklyn Edison Company to carry out its plans was passed by the last Legislature, and is now before the governor.

Phœnixville, Pa.—The Phœnixville Electric Light and Power Company has been incorporated by J. L. Brower and others, with a capital stock of $5,000.

Willimantic, Conn.—The Willimantic Electric Light Company will have everything in readiness for the operation of its plant to supply town lights by June 1.

St. Thomas, Ont.—The St. Thomas Gas and Electric Light Company have again secured the contract to light the city by electricity. This time the contract runs for three years.

Huntington, W. Va.—Mr. J. L. Caldwell has bought the control of the Huntington Electric Light Company, which he will operate in connection with his new electric street railway.

Goshen, N. Y.—A special dispatch from Goshen states that a farmer there has bought a small dynamo, which is to be run by water-power. It is to furnish light for carrying on farming operations at night time.

Yarmouth, N. S.—The new steamer "Dartmouth," built by the Burrill Johnson Iron Company for the Halifax & Dartmouth Steam Ferry Company, has been supplied with a plant of 50 incandescent lights.

Birmingham, Ala.—The capacity of the Birmingham Edison station will be very much increased, as already announced, as the company will put in a 200 h. p. engine and dynamos, with a capacity of 2,400 lights.

Western Orders.—The Thomson-Houston office in Chicago reports among recent sales a small incandescent plant to go to Los Angeles, Cal.; a 50 arc light plant for Excelsior Springs, Mo., and a 250 light incandescent plant for Belding, Mich.

Cortland, N. Y.—The Hitchcock Manufacturing Company have been given an exclusive electric light franchise for ten years. The price of the lights is not to exceed 30 cents per night, and the village trustees are entitled to place their fire alarm wires on the electric light poles.

Jersey City.—The Jersey City Electric Light Company is to introduce the incandescent light, and has put in the storage batteries of the Electrical Accumulator Company. Mr. L. F. Lyne is the superintendent. The company is now running 15 arc-light machines with a capacity of 260 lamps.

New Orleans, La.—It is stated that the plant of the Southwestern Brush Electric Light and Power Company has been purchased by the Westinghouse Electric Light Company, Pittsburgh, Pa. The plant was sold to satisfy a judgment of $32,000. The amount paid aggregated, it is said, $71,000.

Marshall, Tex.—The Westinghouse alternating plant of 650 lights of the Marshall Electric Light and Power Company was started on May 1 by Mr. Norman Marshall, of the Marr Construction Company, and has since been in highly successful operation. A Westinghouse automatic engine 10 × 12, is belted direct to the dynamo. The boiler was made by the Erie Iron Works, of Erie, Pa. The steam plant includes a National heater and a Deane pump.

APPLICATIONS OF POWER.

Orlando, Fla.—The Orlando Street Railroad Company is buying motors for its electric railway.

Newark, O.—The Newark and Granville Electric Street Railway Company has been incorporated, with a capital stock of $100,000.

Philadelphia.—The Sprague Company have just received an order for a large number of motors to be used inthe new marble building of A. J. Drexel, Philadelphia. The average power of the motors is about 7½ h. p.

White Plains, N. Y.—The Sprague Electric Railway and Motor Company are just completing an installation of electric motors at the "Ophir Farm," White Plains, N. Y., the country residence of Mr. Whitelaw Reid. The motors are to be used for pumping water, stable work, and other purposes.

Cincinnati, O.—Proposals for the construction and operation of a street railway by electricity or other power will be received until June 2 by H. Schlotman, Jr., clerk of the Board of County Commissioners, Cincinnati.

PERSONALS.

Mr. Elmer A. Sperry was announced to read a paper before the Chicago Electric Club on May 21 on "The Use of Motors on Alternating Current Circuits."

Mr. G. W. Mansfield, of the Thomson-Houston Electric Company, will read a paper to-night on "Elevated Railroad Systems and their Adaptability for Electric Propulsion" before the Boston Electric Club.

Mr. W. J. Wenstrom, the inventor of the Wenstrom dynamo, is about to visit this country in the interest of the Swedish Government with regard to electrical matters. Mr. Wenstrom is a highly capable electrical engineer. He will make his headquarters with Mr. B. Blum, Room 3, No. 5 Dey street.

Mr. Frank J. Sprague will read a paper before the American Institute of Electrical Engineers on June 12 on "The Solution of the Municipal Rapid Transit Problem." This paper, dealing with a great subject, will be one of the most important ever presented before the Institute. It will be accompanied by numerous illustrations, diagrams, etc.

MISCELLANEOUS NOTES.

Roasting Peanuts.—The invention of an electric peanut roaster is reported.

New York.—The Primary Electric Company of New York has been incorporated by H. J. von Metzradt and others with a capital stock of $240,000.

New York City.—The general term of the New York Supreme Court has decided that the Third Avenue Railway Company cannot use cables on its line in place of horses.

Copper Deposition.—Dr. J. E. Taylor, in the "Science Notes" which he contributes to the *Star*, says: "Among the numerous processes to which modern electricity is being applied is that of depositing pure copper from the natural impure ores. Dynamos are used for the purpose, and quite a new industry is springing up at Widnes, in Lancashire, and also at Swansea. At both places two firms are depositing forty to fifty tons of copper each by means of electricity."

BUSINESS NOTICES.

The Eddy Electric Manufacturing Company has removed its office and factory to Windsor, Conn., where all correspondence should be addressed.

Frames of every description for showcards and pictures can be had of William Levin, 37 Dey street. Quality and promptness guaranteed. Catalogue and estimates on application. A full line of elegant pictures low, for cash.

Jordan & Gottfried, 208 Canal Street, N. Y., carry a complete stock of iron and brass machine and wood screws, bolt cap and set screws, taps, dies, files, twist drills, brass and rubber tubing, rod and sheet copper, brass, German silver, steel and iron wire, shafting, tools, etc.

Hine & Robertson, 45 Cortlandt st., N. Y., are pursuing a novel method of inducing electric light companies to try "Eureka" Packing. To every new customer ordering direct from them 15 pounds or more at regular price, 75 cents per pound, they will send a handsome 8-day calendar clock, 12 in. dial, 24 in. high, or set of brass oilers and tray, 6 pieces, best made. This is an easy way to secure one of these necessary articles and get a packing indorsed by the most prominent electric light plants.

The Page Belting Company, of Concord, N. H., report business as very active during the past month with general trade in their belting, both tanned and "Hercules rawhide," and in the "Hercules" lacing and tanned lacing very satisfactory. Among the special orders which they have received are the following: Belting for the large new brewery being erected by Frank Jones, of Portsmouth, N. H.; main driving belts and dynamo belts for the electric light plant for the Pittsburgh Railroad, at North Adams, Mass.; a large shipment of "Hercules rawhide" belting has been made to Tokio, Japan, also a large shipment of "Hercules" lacing sent to Hamburg, Germany.

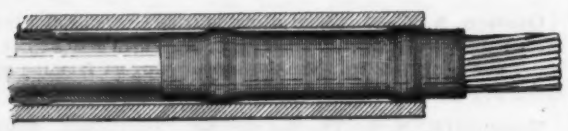
Jas. W. Queen & Co.—The well-known establishment of Jas. W. Queen & Co., of Philadelphia, was established no fewer than 35 years ago. It has now grown to be one of the largest in the country, and manufactures and deals in every class of optical and philosophical apparatus, including electrical, to which special attention is paid. The *Scientific American* of April 28 contains an elaborate illustrated article on the factory, stores and offices of the concern, giving an excellent idea of the extent to which the firm have developed their business in all the old and new departments of physical research and application. The firm are also shown to be large manufacturers of engineering and drawing instruments, as well as of the stationery and other materials required by draughtsmen and engineers.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

PATENTS DATED MAY 15, 1888

(1) 382,714. (2) 382,715. (1) Switch for Electric Motors; (2) Switching Device for Electric Motors. Richard H. Mather, Windsor, Conn.; applications filed respectively Jan. 29, 1887, and Feb. 19, 1887. These are two devices for cutting out of and cutting into a constant current circuit a motor in a gradual manner in order to prevent sparking. It is done by means of a rheostat.

382,734. Coin-Operated Electrical Apparatus; Norman W. Russ, London, England. Application filed Jan. 8,



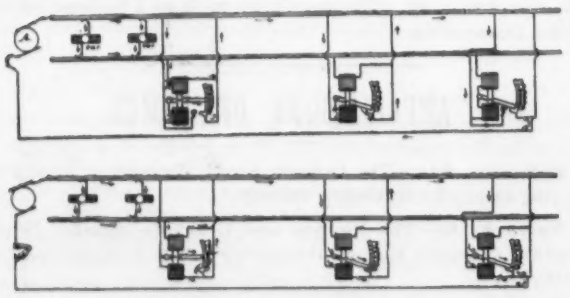
382,767. MANUFACTURE OF TELEGRAPH CABLES.

1888. Patented in England July 17, 1886, No. 9,310; in France April 19, 1887, No. 182,971, and in Belgium April 20, 1887, No. 77,150. There is a receptacle to hold a battery, coil and connections, all of which are worked or set in action, preferably by the movement of the foot on a treadle, in such manner that contact is made with the coil, and the coin receiver is brought forward into such position that the circuit is completed through the coin, which cannot take place unless the coin has been previously inserted in the receiver for same.

382,738. Galvanic Battery; George H. Sloane, Boston, Mass. Application filed Aug. 31, 1887. The fourth claim sets forth the construction as follows: In a battery, the combition of an outer cell, an inner cell, a cover for the outer cell provided with an opening opposite the inner cell, a cover for the inner cell, which shuts over the opening in the cover for the outer cell, said covers being rabbeted, and a packing in the rabbet of the outer cover, the upper edge of the inner cells extending between said packing and the shoulder of the rabbeted cover of the inner cell, substantially as described.

382,766. Electro-Magnetic Car-Brake; Albert P. Massey, Watertown, New York, Assignor to the Eames Vacuum Brake Company, of same place. Application filed Feb. 16, 1887. A brake in which the valves are operated by a variation of pressure in a given space, a chamber of such capacity that the air contained will, when opened to the space for actuating the main valves, vary the pressure in the space sufficiently to cause the fluid to actuate the main valves controlling the application of the brakes. An electro-magnet operates the valves.

(1) 382,767. (2) 382,768. (3) 382,829. (1) Manufacture of Telegraph Cables; (2) Method of Manufacturing Electric Cables; (3) Telegraph Cable; William R. Patterson, Chicago, Ill., Assignor to the Western Electric Company, of same place. Applications filed respectively July 18, 1887; July 18, 1887, and Feb. 2, 1886. (1) The object of the invention is to reduce the electrostatic capacity of the cables by avoiding compression of the insulation of the conductors throughout the length of the cable, as heretofore, and



382,877. ELECTRIC RAILWAY.

at the same time to cause the pipe to fit tightly to the core at intervals, so that in case of a break or leak water would not penetrate to any considerable distance. See illustration. (2) The conductors are twisted into a cable so that there will be a space left between them. In other words, the strands are but loosely twisted, thus making a cable of the lowest electrostatic capacity. (3) The lead tape winding is protected by dry paper tape on both sides.

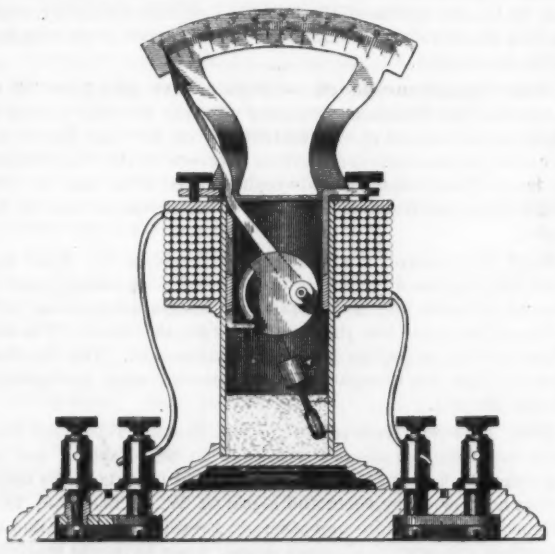
382,778. Underground Conduit for Electric Wires; Walter F. Smith, Philadelphia, Pa. Application filed Jan. 24, 1888. The conduit consists of two curved plates placed some distance apart, forming a double arch. The intervening space is divided by longitudinal partitions. The arch may form the roof of a sewer,

382,788. Automatic Fire Alarm; John Young, Chicago, Ill., Assignor to the Western Electric Company, same place. Application filed May 21, 1883. An arrangement whereby false alarms may be recognized at the station houses as such.

382,811. Electro-Medical Apparatus; Peter Horst, Sioux City, Iowa. Application filed Oct. 5, 1887. The invention consists of a hard rubber grooved disc carrying a small metallic plate on its under side and a large metallic plate on its upper side, of conductors held in said rubber disc, and connecting the under side of the latter with the metallic disc on top of the rubber disc, and of a collector for frictional electricity held between the top disc and the hard rubber disc.

382,845. Commutator for Dynamo-Electric Machines; Nikola Tesla, New York, N. Y., Assignor of one-half to Charles F. Peck, Englewood, N. J. Application filed April 30, 1887. The commutator is a disc having alternate segments of insulating and conducting material inserted in its face. The collector, or what takes the place of a brush, is a similar disc provided with like segments. The faces of the two discs bear upon each other, and the current passes from one to the other.

382,846. Manufacture of Incandescent Electric Lamps; Edward P. Thompson, Elizabeth, N. J. Application filed Feb. 4, 1887. A method of expelling the occluded gases from the carbon joints formed by the union of the filament with the leading-in wires. This is accomplished by heating the leading-in wires and the joints independently of the filaments themselves, both during the process of evacuation and after the air has been



382,914. ELECTRIC INDICATOR.

exhausted by means of currents caused to pass from an independent conductor to the respective joints and through the filament.

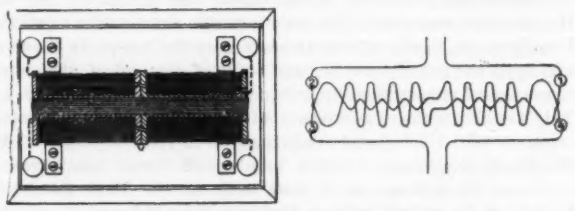
382,856. Repeating Induction Coil; John A. Barrett, Brooklyn, N. Y. Application filed Jan. 14, 1888. This invention is an improvement in repeating coils for telephonic circuits. The repeating coil or inductorium is a species of induction coil peculiarly constructed for the special purpose of utilizing electrical induction as a means of reproducing in a given circuit the voice currents originating in another circuit. See illustration.

(1) 382,876. (2) 382,877. Electric Railways; Rudolph M. Hunter, Philadelphia, Pa., Assignor to the Electric Car Company of America, of same place. Applications filed respectively March 18, 1886, and July 19, 1886. (1) Means for increasing the counter electromotive force until the motor becomes a generator, and then driving the same by the momentum of the car. (2) Two lines of working conductors are made in sections, the sections of one line being connected together through resistances, and sections of the other lines being connected with the sections of the first mentioned line. A generator is connected with the opposite ends of the respective lines, whereby motors upon the line may be coupled in series with each other. See illustration.

382,914. Electric Indicator; John Tregoning, Hartford, Conn. Application filed May 23, 1887. A solenoid having an armature eccentrically pivoted therein and provided with a lever carrying an adjustable counterpoise and fan. See illustration.

382,941. Electrical Agricultural System; Edward M. Bentley, New York, N. Y. Application filed Dec. 11, 1885. For running agricultural machines by electricity. The invention consists in suspending a line of conductors along one side of a field or district and providing a secondary conductor having a length equal to the transverse dimension of the field, which has a traveling contact on the main line, and with which the moving motor is in constant connection. See illustration.

382,968. Storage Battery; Charles D. P. Gibson, New York, N. Y. Application filed March 31, 1887. The perforations in the plates are filled by immersion in a solution and exposure to a current. The cells are filled by the disintegration of the plates or by deposit from the solution. The plates are subsequently



382,856. REPEATING INDUCTION COIL.

exposed to the air to crystalize the active material and absorb oxygen.

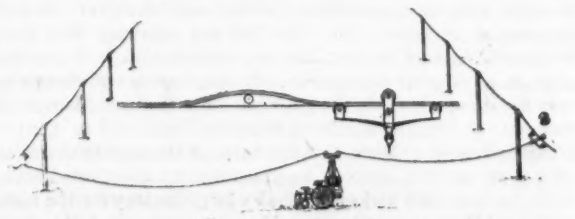
382,976. Electric Tele-Thermoscope; Harry Williams Hardinge, Leadville, Colo. Application filed Aug. 28, 1887. An arrangement of thermostat with a pair of pulsating bulbs. The latter are adapted to receive mercury, which is forced into them by the expansion of air in a closed chamber caused by differences in temperature. The mercury closes certain alarm circuits.

382,990. Electrically Propelled Vehicle; Walter H. Knight, New York, N. Y. Application filed Jan. 20, 1888. The regulator for controlling the propelling motor is adapted to be operated from both ends of the car by the same mechanism which operates the car brake.

382,997. Directory Indicator for Buildings, etc.; Thomas J. McTighe, New York, N. Y. Application filed May 24, 1887. By the operation of a key in the several office rooms, a sign may be posted on the directory at the entrance of the building to indicate whether the occupants of the rooms are "in" or "out."

383,046. Incandescent Lamp Attachment; Harry M. Doubleday, Columbus, Ohio. Application filed Sept. 1, 1887. A bracket connected with the chandelier near the burner, consisting of an arm having a perforation at its outer end to receive a sleeve. The sleeve grasps the neck of a lamp.

(1) 383,013. (2) 383,014. (3) 383,015. (4) 383,016. (5) 383,017. (6) 384,018. (1) Telephone Exchange System; (2) Switch-Board; (3) Clearing Out Annunciator; (4) Automatic Shunt for Magneto Generators; (5) Test Circuit for Telephone Call Boxes; (6) Key-Board Apparatus for Telephone Exchanges; Charles E. Scribner, Chicago, Ill., Assignor of all of the above patents to the Western Electric Company, same place. Applications filed respectively March 5, 1883 June 16, 1884; Dec. 27, 1886; Dec. 3, 1885; April 5, 1886, and Dec. 27, 1886. (1) A device by means of which the subscriber may ground his metallic circuit through his telephone, and connect the two wires with the central office as



382,941. ELECTRICAL AGRICULTURAL SYSTEM.

a single ground circuit. (2) A weight takes up the slack of the cord attached to the plug on switch-boards. (3) Means whereby the subscriber may call another after their lines have been connected at the central office, and means whereby the subscriber may call central office while the line is connected with another. (4) A shunt circuit around the machine is automatically closed by the movement of the armature. (5) The generator and call-bell of the box may be used for making the required tests. (6) The same apparatus is used to connect two ground circuits or a ground with a metallic circuit.

Copies of the specifications and drawings complete of any of the patents mentioned in this record—or of any other patents issued since 1866—can be had for 25 cents. Give the date and number of patent desired, and address Johnston's Patent Agency, Potter Building, New York.